THE
INTERNATIONAL SUGAR JOURNAL

VOL. LX SEPTEMBER, 1958 No. 717

NOTES AND COMMENTS

Booker Bros. McConnell & Co. Ltd., 1957 Results.

In 1957 conditions were more favourable than in 1956—indeed so far as world sugar market prices were concerned exceptionally favourable—and the sugar estates had a thoroughly successful year.

The wet weather in the autumn of 1956 combined with a dry 1957 spring gave a heavy, well-ripened spring crop with excellent yields of sugar. However, the failure of the mid-year rains (a most unusual event) coming after this dry spring led to lower yields in the autumn crop. With this dry weather during 1957 rainfall during 1958 will be a particularly important factor; another dry year could seriously affect the 1958 crop.

Once again several records were broken. The estates for which Bookers are responsible produced 236,677 tons of sugar, an increase of 23,574 tons over the record production of 1956. The overall yield for the Booker estates was 3·66 tons sugar per acre as against the previous record of 3·63 tons sugar per acre. Seven out of the ten factories broke production records. The Rose Hall factory produced 45,270 tons of sugar to beat its 1956 record of 30,915 tons. Some measure of the results of the factory rehabilitation which has been going on over the last ten years is afforded by the fact that since 1950 the average yearly factory output has nearly doubled—from just over 12,000 to just under 24,000 tons. This is a considerable achievement when one remembers that this reconstruction has been carried out while at the same time the factories were grinding larger and larger crops.

Financially there was a great improvement over the inadequate levels of profits achieved in the past few years. This was largely due to a fortuitous rise in the price of sugar on the world market, which affected nearly 45% of the sugar exported. In these exceptional circumstances the Sugar Industry paid a once-for-all bonus on wages amounting to one million West Indian dollars. It is particularly pleasant to be able to report on circumstances which have enabled the Industry to share with its work-people the fruits of a successful year. At the same time the opportunity was taken to increase expenditure on the maintenance and improvement of fixed assets on the estates. The price of world sugar has now dropped to pre-1957 levels.

With the probability of continuing low world sugar prices ahead, it is—as was said last year—only through the fruits of research and by ever-increasing efficiency that the Industry will survive and prosper. It is in the cane field that there is most promise of future reductions in costs. The stage has now been reached when the overall fertilizer requirements of sugar cane in British Guiana are known, and investigation of individual field-to-field variations is now being undertaken. Scientific methods of irrigation control are under study; the present cycle of dry weather has emphasised the need to make the best possible use of our water supplies. In wet weather, on the other hand, the difficulty is not to grow cane but to ripen it. The use of growth inhibitors and defoliants for forced ripening is being investigated. As a result of improved agricultural technique it has been possible to lengthen the ratooning cycle—the number of years cane will grow from the same roots without replanting; this, in the long run, should have a marked effect on field costs.

The immediate capacity of British Guiana's export market has been reached and efforts will now be directed towards maintaining the present level of production in the most suitable areas.

The Company's factories continue to improve. During the year the new mill house at Ressouvenir was opened by the Governor, Sir PATRICK RENISON. The very heavy sugar machinery for the factory, in its new buildings, is erected on multi-cellular, pre-stressed concrete rafts. This is the first application of this type of foundation in the world. When construction work is completed the Ressouvenir Estates will possess the only factory in British Guiana that has been designed and erected as an entity.

Plans are well advanced for the bulk storing and handling of sugar. A suitable site near Georgetown for a store and wharf has been selected; the store will hold 40,000 tons of sugar. Construction is likely

to start in 1958 and it is expected that the project will take two years to complete. The store, through which all raw sugar exported from the territory will pass, will be operated by a new company to be called "Demerara Sugar Terminals Limited", in which Bookers Shipping (Demerara) Limited will have an 80% interest, the remainder being held by Sandbach, Parker & Company Limited.

It has been possible to arrange with the Government that the Sugar Industry Rehabilitation Fund should make a substantial contribution to the finance of this project. The Fund will invest in debentures of the new Company which will be repayable over twenty years, beginning five years after issue. The Sugar Industry Rehabilitation Fund is one of the three Funds, the other two being the Labour Welfare Fund and the Price Stabilisation Fund, which were started at the end of the war; it has been built up over the years by a levy on all sugar exported and is administered jointly by representatives of Government and Industry. As well as building the wharf and store in Georgetown, it will be necessary to make alterations at each of the factories so that they can deliver sugar in bulk instead of in bags.

The last twenty-five houses of the pilot cane farming scheme have now been allotted to tenants; and the village of fifty-seven houses, with its sports ground, presents an attractive appearance. The basic problem of the scheme remains that in British Guiana it is necessary to use scientific methods of cultivation to obtain profitable yields; and it is difficult to maintain conformity with required agricultural techniques while retaining a sturdy sense of independence among the farmers. It is still too early to make any final judgment but the scheme continues to make progress.

* * *

Record-Breaking Crop in Taiwan.[1]

The Taiwan Sugar Corporation has just harvested its biggest crop since the war. A total of 930,000 metric tons were made of which 55% was white and 45% raw sugar. The biggest ever made on Taiwan was 1,400,000 metric tons in 1939, harvested from about 170,000 hectares (420,000 acres) and crushed by 48 mills with an aggregate daily capacity of 70,000 tons. The current crop was harvested from about 90,000 hectares (230,000 acres) operating 27 mills of 53,000 tons daily grinding capacity. The yield of sugar per acre of the current crop is about 15% better than that of the 1939 crop. One raw house (Suantow) was rebuilt and converted into a white sugar factory.

Complaints from customers that Taiwan raw sugar contained more starch as impurities than they found in the competitors' products led to exhaustive investigation in the laboratory and factory. This revealed that the cane variety N:Co 310 was exceedingly rich in starch as it matured (about 0·2% on solids). The presence of excessive starch in raws slows down the refinery's filter station operation, which is costly. The clarification stations of the thirteen raw houses were remodelled, and chemicals conducive to starch removal were employed in places where facilities were inadequate. New sugar samples sent to customers and to Hawaii for evaluation have been found satisfactory. Complaints of contamination with iron rust led to replacement of some pan floor pipelines with a non-corrodible type and painting of surfaces where sugar might come into contact. In addition a sedimentation test was incorporated into daily routine quality control procedures.

Sugar cane on Taiwan is harvested and processed during a dry season, and factory water supply in certain locations last year on Taiwan was insufficient. The places which needed surface water were short of underground water also. Consequently sources other than wells had to be resorted to. Natural draught cooling towers designed by TSC engineers were erected in four factories. The result has been that no factory in the 1957/58 season was stopped because of water shortage.

* * *

Cane Wax Recovery Process.

The U.S. Dept. of Agriculture announced a short time ago[2] that its Research Service in New Orleans had developed, on a small scale, a process for extracting wax from cane residues. Large-scale studies are needed before it will be ready for commercial use, but it is said to appear practical for use in small and medium mills, compared with the Cuban process which is only suitable for large mills. Briefly, the wax is extracted by slurrying with hot heptane, filtering to separate the heavy impure residue, and recovering the wax by a combined evaporation and stripping operation. The U.S. annually imports more than 10,000 short tons of vegetable waxes, worth about $10 million. Of this some three-quarters is carnauba wax which is similar to cane wax.

* * *

Sena Sugar Estates Ltd., 1957 Report.

The Company's factories produced 119,025 tons of sugar from 1,035,625 tons of cane in the year ended 31st December 1957. This was considerably higher than in any previous year and was due to favourable weather combined with new varieties and increased use of fertilizers. The factories were kept fully supplied with cane which they crushed at a higher rate than ever before.

In 1958, when the Zambesi river flooded, reports were received of the alarming rise in the water level and defences were strengthened and manned continuously so that at the height of the flood an aerial photograph showed the two estates as the only green and dry areas in a wilderness of water. Only a few hundred acres of cane were lost and these have been replanted. Both the sugar factories started crushing on 28th April and cane supplies appear adequate. Large sums have been spent on sugar storage and the quality of the semi-refined white sugar for local sale is being improved. A final dividend of 6% was declared in addition to the 4% interim dividend in February.

[1] *Taiwan Sugar*, 1958, **5**, (5), 27–28.
[2] 5th May, 1958.

HEAT TREATMENT EFFECTS ON TWO SUGAR CANE VARIETIES IN BARBADOS

By G. C. STEVENSON and D. I. T. WALKER
(British West Indies Central Sugar Cane Breeding Station).

INTRODUCTION

THE identification of a transmissible disease causing depressed growth, particularly in ratoons, was first made in Australia in 1949, in the variety Q 28. This came to be known as "ratoon stunting disease". Significant depression of yield in artificially infected crops, and increases in yield after heat treatment of the planting material, have been clearly demonstrated there, with the loss sometimes as high as 60% in ratoons. By 1952, the same team of workers had tested a curative treatment—heating setts in water at 50°C for 1½–2 hours—and the control of the disease on a commercial scale appears efficient.[1]

The scare of the disease soon spread to other sugar areas, and in many of them yield trials have proved the presence of ratoon stunting disease as a factor in poor yields. In 1953, the British West Indies Sugar Association invited Mr. D. R. L. STEINDL, Pathologist in the Australian Bureau of Sugar Experiment Stations, to visit the West Indies area, to examine growing cane for suggestions of ratoon stunting disease, and to give advice accordingly. While in Barbados Mr. STEINDL sampled eight typical estates and a range of commercial varieties, and expressed himself suspicious that some of the symptoms (i.e. discoloration of vascular tissues at the nodes in cut canes) that he found could be those of ratoon stunting disease, but declined to give any more positive diagnosis. In this the senior author would agree; never in Barbados has he seen ideal text-book examples of symptoms as he has in the variety H 37-1933 in Hawaii. In his report circulated later, Mr. STEINDL considered that good symptoms had been seen in scattered fields of all the commercial varieties (B 34104, B 4098, B 41227, B 43391, B 4744 and B 47419) except the major one (at that time) B 37161. With this evidence, *as a precautionary measure* he recommended treating stocks of all the commercial varieties in Barbados, for distribution to estates where they would replace original stocks.

Nurseries were duly established after the long hot water treatment (50°C for two hours), and cuttings from them were distributed to growers at the end of 1954; "cleaned" stocks now occupy an estimated third of the acreage. Legislation was not introduced, as it was in Australia, compelling growers to convert entirely to these stocks, and in fact many of them maintained both types alongside one another. Comparison between the two on such estates was the foundation of the series of observations reported here.

OBSERVATIONS.

(*a*) A number of growers claimed that the new material had some different characteristics from the original variety, particularly in that most widely grown, B 37161. A great increase in arrowing (flowering) was noticeable, and there were some claims of reductions in yield.

(*b*) The Station's breeding collection was also heat treated, and within two or three years all the parent varieties had been propagated from heat-treated material.. In a general way it appears that some varieties which were formerly very shy to arrow now do so more freely—among them B 37161, Co 290 and Badila.

(*c*) A replicated trial containing the following treatments was planted out in November 1954:—

(*i*) B 37161 normal planting material (not inspected for symptoms);

(*ii*) B 37161 planting material (from a nursery originally heat treated);

(*iii*) B 41211, as (*i*);

(*iv*) B 41211, as (*ii*).

Reaped in February 1956, and as first ratoons in February 1957, there were no differences between treatments in this trial (Table I).

Table I.

YIELD (TONS CANE PER ACRE) IN TRIAL (*c*).

		Plant Canes 1956	1st Ratoons 1957
B 37161	treated	32·02	19·89
B 37161	untreated	32·61	22·84
B 41211	treated	28·44	23·30
B 41211	untreated	25·66	23·23

(*d*) An observational trial in paired plots was laid down in 1955, using B 41211, with the following treatments:—

(*i*) Planting material apparently free from internal stem symptoms, from a heat treated nursery.

(*ii*) Planting material soaked in an infusion of juice prepared from canes of several varieties showing marked nodal discoloration symptoms.

Average weights from six plots of ten stools in each treatment reaped as first ratoons in 1958 were as follows:—

"clean" 43·5 tons per acre;

"infected" 43·8 tons per acre.

Clearly there are no differences in this trial.

(*e*) A latin square layout was established in November 1956 on an estate where the Manager had obser-

[1] HUGHES and STEINDL: *Tech. Comm.* (Bureau Sugar Expt. Sta.), 1955, (2), 54 pp.

vations of type (*a*). Planting material from the estate was used. The treatments were:—

(*i*) B 37161, original stocks;

(*ii*) B 37161, clean, from heat-treated nurseries;

(*iii*) B 41211, original stock;

(*iv*) B 41211, clean, from heat-treated nurseries.

It should be mentioned that stocks (*ii*) and (*iv*) had been propagated at least twice since heat treatment.

Each plot contained 7 × 10 stools, of which 5 × 8 stools were used for records. Average results from the plant cane crop (February 1958) are shown in Table II. Cane number, yield and percentage arrowing were the main measurements considered. The juice figures are derived from sample bundles milled at 55–60% extraction.

Table II.

DATA FROM TRIAL (*e*).

	B 37161		B 41211		Treated	Untreated
	Treated	Untreated	Treated	Untreated	Mean	Mean
Tons cane per acre	41·25	44·78	43·87	49·48	42·56	47·13
Lb per cane	4·42	4·70	4·25	4·16	4·33	4·43
Cane number per plot	490	495	535	639	513	567
Arrowing %	56	4	20	4	38	4
Sucrose in juice %	17·2	17·4	13·8	15·2	15·5	16·3
Apparent purity	88·3	88·0	74·1	77·0	81·2	82·5

Differences in juice quality were not significant. Nor were those for cane number and average weight per cane. The difference with treatment in yield-per-acre was significant at the 2% level, while that for arrowing was, of course, highly significant.

Heated stocks are, therefore, showing greatly increased arrowing and slightly lower yields than the original stocks, as suggested by the estate Manager.

The correlation between yield and arrowing is good in B 41211 ($r = -0{\cdot}87$). but is not significant in B 37161 ($r = -0{\cdot}38$). Arrowing would presumably affect yield by curtailing extension growth, by pithiness and by drying-out of the stalks affected. If these factors are responsible for the yield loss in this trial, the weight per cane should also be negatively correlated with arrowing. However, there is no evidence of such a correlation. This effect may be minimised in this case, because the trial was reaped fairly early in the season, though after a relatively dry December and January. In spite of this, the variety (B 41211) showing the smaller (17%) increase in arrowing shows the larger (5·61 tons) reduction in yield. In part the yield reduction may therefore be due to a direct effect of the hot water treatment; further results, including weights of arrowed and non-arrowed canes, will help to clarify these points.

It should be noted that there was no question in this trial of the untreated plots having insufficient vigour to reach flowering condition. This explanation is likely where yields are seriously reduced by the disease, as for example in Australia in the variety N:Co 310 (Fig. 12 of reference[1]). The curing of the disease more than counteracts any small effects of heat treatment in reducing yield there, but cannot apply in the conditions of this trial.

The trial will be reaped in ratoons, and similar trials with the varieties B 45151, B 4744 and B 49[illegible] will be initiated this year.

DISCUSSION and CONCLUSIONS.

From this preliminary data it seems certain that ratoon stunting disease has not been detected in Barbados. Varietal deterioration has not been noticeable in Barbados; apparent lowering of yields in older varieties (particularly B 37161) is, in fact, due to new varieties having superseded the old. This is supported by analyses of yield data in the island.

Although no general recommendation can be made based on the yield differences at this stage, arrowing is a sufficiently serious factor in later reaped crops in Barbados to say that heat treatment has been deleterious to plant canes of B 41211, and probably to B 37161.

In particular, it is clear from trial (*d*) that nodal discoloration symptoms are unsatisfactory as a basis for diagnosis of the disease. Similar conclusions were drawn by SMITH[2] with regard to Jamaica, where only Co 421 has been shown to show ratoon stunting proper. Indeed, similar conclusions can be drawn from HUGHES and STEINDL's original review (Table VI of reference[1]) reproduced here as Table III.

Table III.

VALUE OF DIAGNOSTIC SYMPTOMS FOR RATOON STUNTING DISEASE IN VARIOUS VARIETIES

Variety	Effects on Yield	Nodal Discoloration
Q 28	severe losses	obvious symptoms
Vesta	severe losses	variable
POJ 2878 ..	severe losses	variable
Q 813	severe losses	often difficult to find
Co 301	small losses	obvious symptoms
Q 57	small losses	difficult to find
Co 290	none proved	obvious symptoms

It seems most probable that a variety of conditions apart from genuine ratoon stunting disease can produce a physiological reaction resulting in similar nodal symptoms. Poor drainage in particular has been quoted. Specific colour tests for the disease may prove useful when fully developed, but are not so at present[3,4].

[2] *Jamaican Assoc. Sugar Tech. J.*, 1955, **18**, 29–31.
[3] FARRER: *Abstr. Phytopathology* 1957, **47**, 10.
[4] ANTOINE: *Nature*, 1958, **181**, 276.

When embarking on a heat treatment programme—which is a fairly expensive operation—a more reliable diagnosis is needed. For areas where yield data are not available for analysis to prove varietal deterioration or exceptionally poor ratooning in the absence of pests, there is at present no alternative for well designed infection tests and heat treatment trials to obtain yield data.

The new strains of B 37161 and B 41211 with high arrowing as a new fixed character (in vegetative generations, at least), pose some interesting questions genetically. A nuclear change (gene mutation) is unlikely, but a cytoplasmic one is quite possible. Cytoplasmic particles may be infective (viruses); and they may persist through sexual generations. Tests for the infectivity of the free-arrowing propensity, and records of progeny from the two strains of B 37161 crossed with standard male parents, will be made shortly. The nature of the change may then be more fully understood. If the character proves fixed genetically, a very undesirable change will have been made in the characteristics of our breeding collection.

SUMMARY.

In the apparent absence of true ratoon stunting disease from Barbados, heat treatment is shown to increase arrowing, and probably to reduce cane yields, in two varieties. It is suggested that visual diagnosis by nodal discoloration symptoms is inadequate as a basis for embarking on a heat treatment programme to cure the disease. The genetical implications of the change of arrowing habit are discussed.

* * *

D. R. L. STEINDL writes:—

In their article "Heat Treatment Effects on Two Sugar Cane Varieties in Barbados" G. C. STEVENSON and D. I. T. WALKER indicate that when visiting Barbados in 1953 to make inspections for the presence of ratoon stunting disease I expressed myself as being suspicious that symptoms seen were those of ratoon stunting disease, but in a later report I considered that good symptoms had been seen. My recollection is that at all times I expressed the opinion that symptoms seen there resembled those which are associated with ratoon stunting disease in Queensland, and I considered that the disease was probably present in Barbados, as well as in other islands of the British West Indies. However, I stated that this diagnosis should be confirmed by the inoculation of a susceptible variety such as Q 28 with juice from the suspected canes.

We have never claimed that the disease can be positively identified under all conditions by the internal discoloration of the nodal tissues. This discoloration varies greatly with varieties, and under different conditions of growth, and sometimes diseased cane shows no symptoms at all. The only Barbados variety which we have tested here against ratoon stunting disease is B 41227. This variety showed very poor internal symptoms when infected with the disease and the decrease in yield was slight.

The observations on the effect of heat treatment on arrowing are of considerable interest. In Queensland we have noted some depression in arrowing when ratoon stunting disease causes a severe check in growth, but no differences have been seen as a result of hot water treatment alone. The varieties mentioned by Messrs. STEVENSON and WALKER, namely Co 290, Badila, B 37161 and B 41211 and some hundreds of other varieties, have all been treated here at 50°C for three hours, which is now our normal practice, and none has shown any tendency to arrow more profusely as a result of the treatment. In fact, the two Barbados varieties mentioned failed to arrow at all during the past season. It was not a good arrowing year, but we could have expected some arrows if the varieties had been rendered at all free-arrowing by the treatment.

We look forward with interest to any further results from investigations along these lines.

AGRICULTURAL ABSTRACTS

Dual Action Seed Treatment for Sugar Cane. R. MUTHUSWAMI and P. ARAVAMUDHAN. *Indian J. Sugarcane Res. Dev.*, 1958, **2**, 61–70.—The results are recorded of a single year's trial of a number of organomercurial fungicide/insecticide compounds with which the setts were dressed. In yield, no significant difference was found between "Aretan/Aldrin," "Aretan/Dieldrin," and "Aldrin," but the two former increased tillering, the number of nodes and length of cane as well as stimulating arrowing. All three, with "Dieldrin," gave exceptionally good protection against termites.

Studies in the Post-Embroyonic Development of *Aplanetes flavipes* CAM (Braconidae-Hymenoptera). S. MOHAMMAD ALI and A. R. PRASAD. *Indian J. Sugarcane Res. Dev.*, 1958, **2**, 71–75.—The grub period of this parasite of the sugar cane borers varies from 7 to 23 days, and the cocoon period from 5 to 7 days in the months of June-November. Partial correlation coefficients indicated that the prevailing minimum temperature range (72°—85°F) alone influenced grub period; the cocoon period was too constant throughout to be materially affected. The sex ratio ♀ ♂ was 3:1.

THE SUGAR CANE IN TAIWAN

REPORT OF THE TAIWAN EXPERIMENT STATION, No. 15, 1957.

THE major portion of the Report, which takes the form of a series of articles, is concerned with the nature of the salt alluvial soils of Taiwan and their reclamation. The soils concerned are situated on the western side and are, broadly, of two classes : a loose, yellow sandstone and a bluish-gray "mudstone" of heavy texture, hard when dry and a thick paste when wet. Both are highly erodible. The four articles dealing with these soils (in Chinese, but with lengthy English summaries) are all by the senior author, S. C. WANG, with different associates in each case.

Two of the articles deal respectively and in considerable detail with the chemical and physical characters of the two classes of soils while a third discusses, in particular, the base exchange reactions. The fourth deals more directly with the reclamation of these soils through the effect of water (irrigation) and carbon dioxide as disclosed by exposure of laboratory samples to the action of both distilled and irrigation water with and without the passage of CO_2 for 0·5 hr on three successive days. On the basis of these experiments a programme of reclamation and subsequent cultivation is outlined. Essentially, it is a programme of lowering the water table, either by ditches or deep ploughing, thereby assisting the removal of salt or carrying it to a deeper level, and of developing increased sources of irrigation water. A stage further in reclamation is the growing of the salt-tolerant *Sesbania sesban* for ploughing in. Subsequently rice is planted with each sixth row left vacant for sugar cane to be planted some 2½ months later. Application of any organic manure is beneficial and residues of all plants, rice straw, cane trash, bagasse and so on should be left as cover during the dry season.

Of the three remaining articles, one, by S. C. WANG and K. Y. LI, compares equal dressings of potash in the forms of muriate, spent wash concentrate and molasses on the yield of cane. The experiment covered two seasons and two soil types, red earth and alluvial sandstone. The effective order was spent wash concentrate, muriate and molasses. C. C. YANG describes an interesting experiment, covering three seasons, with a combination of green manure and cane trash applied directly as compared with the two apart, with trash compost and artificials. A substantial and significant increase of yield over artificials was obtained. The relative improvement from the combination of green manure and trash over either separately is explained on the basis that the green manure counteracts the ill effects of the drain on N by fresh trash early in the season while the trash becomes sufficiently decomposed to supply the plant's needs later, when the effects of the green manure are passing.

The third article, by C. C. YANG, describes a universal indicator for testing soil pH. It is composed of 25 mg methyl red, 60 mg bromothymol blue and 530 mg phenolphthalein dissolved in 100 ml ethyl alcohol. Particularly, it shows distinct colour changes between pH 4-5·5 and pH 8-9·5.

H. M.-L.

AGRICULTURAL ABSTRACTS

The Occurrence of Weeds in Sugar Cane Fields Influenced by Continuous Application of Fertilizers to Soil. P. S. MATHUR. *Indian J. Sugarcane Res. Dev.*, 1958, **2**, 76–87.—The observations are drawn from a long-term fertilizer experiment at Shahjahanpur, Uttar Pradesh, which includes N, P and K dressings singly or in combination and in different amounts. No marked differences were observed in the P and K plots.

* * *

Notes on Foreign Cane Varieties. R. R. PANJE and A. S. ETHIRAJAN. *Indian J. Sugarcane Res. Dev.*, 1958, **2**, 88–93.—A brief record is given of foreign varieties imported into India with special reference to those from Canal Point and the Everglades Experiment Station.

* * *

Break-Pushing Machines. I. T. FRESHWATER. *Cane Growers' Quarterly Bull.*, 1958, **31**, 76–78.—A break-pushing machine built by Edwards and Zampatti and particularly useful in lodged cane is described and illustrated.

* * *

Stubble Shaving on the Herbert River. O.W.D.M. *Cane Growers' Quarterly Bull.*, 1958, **31**, 79, 80.—The "Mizzi" shaver is described and illustrated.

* * *

Soil Conservation in the Childers Area. R. B. MOLLER. *Cane Growers' Quarterly Bull.*, 1958, **31**, 93–96—A useful description is given of the methods employed to control erosion in an area liable to serious damage therefrom.

* * *

Q 67—A New Variety. G. A. CHRISTIE. *Cane Growers' Quarterly Bull.*, 1958, **31**, 118, 119.—Q 67 is a cross, Trojan × Q 27, characterized by its resistance to lodging and a c.c.s. which rises as the season progresses.

* * *

The Problem of Erosion in the French Antilles and the Methods of Protection. H. STEHLÉ. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1957, **2**, 157–166. This fully illustrated article describes the various methods of countering erosion with particular emphasis on the combination of terracing and cover crops.

Agricultural Abstracts

Micro-trials of Sugar Cane; Development of the Varietal Nursery of the Agricultural Research Centre of the Antilles. H. STEHLÉ and R. PETIT. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1957, **2,** 177–186.—In addition to bringing previously published varietal lists up to date, a general review is given of the work of the centre including phytopathology and quarantine.

* * *

Sucrose Formation and Concentration in Sugar Cane. J. L. DU TOIT. *S. African Sugar J.*, 1958, **42,** 205–213.—Anxiety has arisen in South Africa, as in Queensland, at the drop in sucrose content in recent years. The article, which constitutes the Experiment Station Bull. 6, is based on a talk given on the subject. The matter is complicated by varietal changes, but it is shown that, since 1928, when Uba began to be discarded, there has been a slow increase in sucrose content to date amounting to 0·46% cane. This increase, exposed by ironing out the annual fluctuations by averaging, is far below that anticipated from N:Co 310, the richest cane ever grown and now contributing over 50% of the harvest, and this result is tentatively attributed to excessive trash. Behind this is the weather; the combined effect of sunshine and rainfall March–June is closely correlated with the average sucrose content in July and August (R=0·801). The low sucrose of the last two years may be explained on this basis.

* * *

The Effect of Ratoon Stunting Disease on Yields in Louisiana. R. J. STEIB *et al. Sugar Bull.*, 1958, **36,** 163–169.—Very considerable increases of yield of cane, as great in first stubble as in plant cane and amounting at times to over 50%, are reported as the result of treatment of the seed cane with hot air. A slight depression in sucrose/ton cane occurred in some varieties tested.

* * *

Origin and Distribution of *Saccharum*. S. K. MUKHERJEE. *Bot. Gaz.*, 1957, **119,** 55–61.; through *Plant Breeding Abstracts*, 1958, **28,** 1916. Morphological, phytogeographical and cytological studies of *Saccharum*, *Erianthus*, *Narenga* and *Sclerostachya* are discussed and it is suggested that the *Saccharum* complex originated in the India-Burma-China border area, that *Sclerostachya*, *Narenga* and *Saccharum* have a common origin from *Erianthus*, and that further speciation in *Saccharum* resulted from polyploidy and hybridization.

* * *

Breeding behaviour of certain agronomic characters in progenies of sugarcane crosses. L. P. HEBERT. *Diss Abstr.* 1957, 17, Publ. No. 17,444, p. 468; through *Plant Breeding Abstracts*, 1958, **28,** 1920.—At the U.S. Sugarcane Field Station, Houma, La., seven crosses were investigated with respect to stalk diameter, stalk erectness, number of stalks per stool and Brix value and sucrose (pol) content of the juice of the first stubble and of both the plant cane and first stubble of the clones derived from these single stools. Correlation coefficients obtained between single stools and clones indicated that selection for stalk diameter and Brix percentage would be fairly effective at the single-stool stage, provided it was not too rigid, but that selection for erectness and number of stalks per stool at this stage would be less valuable. Brix value and sucrose (pol) content were highly and positively correlated and constitute reliable criteria of selection of clones in any one season. Except for this correlation, the four characters studied were independent. Close association was found between parents and progenies for each character.

* * *

Mechanization on Taiwan Sugar Farms. KUNG KIANG. *Taiwan Sugar*, 1957, **4,** (8), 22-29.—Mechanization is being rapidly extended on the farms of the Taiwan Sugar Corporation and the various types of mechanical units, the different operations to which each is best adapted and the scheme for training staff in their uses are detailed. The Corporation owns 40,000 hectares but there are, in addition, some 50,000 ha of "contract" land on which cane is grown by farmers under contract. There is scope for the extension of mechanization to contract lands. Meanwhile the yields per ha on Corporation and contract lands respectively have risen from 16 and 28 tons to 86 and 76 tons.

* * *

Effect of Lime and Phosphate-bearing Materials on Sugar Cane Yields. J. A. BONNET *et al. J. Agric.* (Univ. Puerto Rico), 1958, **42,** 1-6. On an acid soil (pH 5·6 top soil and 4·0 sub-soil) under humid conditions, neither superphosphate nor hyperphosphate increased yields over a 3 crop period. In combination with lime at 4 tons per acre a significant increase in yield of cane was obtained in all crops, with super-phosphate at 200 lbs. P_2O_5 in the lead.

* * *

Chemical Weed Control—A Review of the Pre- and Post-Emergence Applications of Different Weedicides. I. P. FERRARIS and M. V. LACSON. *Sugar News* (Philippines), 1958, **34,** 119–123.—The article, which forms Release No. 15 of the Victorias Milling Co., describes experiments indicating that 2, 4-D is effective as a pre-emergence control and was cheaper than CMU. TCA gave effective post-emergence control but required care in application since contact with cane leaves caused burning.

THE CHROMATOGRAPHIC DETERMINATION OF DEXTROSE AND LEVULOSE IN RAW SUGARS, MOLASSES AND OTHER SUGAR PRODUCTS

By FRANCES JOAN GARDINER and E. G. MULLER (Tate & Lyle Research Laboratories).

ALTHOUGH both sugar cane and sugar beet store their carbohydrates in the form of sucrose, chemical or enzymatic hydrolysis, occurring during transport and storage of raw sugar and during the various stages of refining, will lead to the formation of "invert sugar" or, more precisely, dextrose and levulose. One or both of these, in turn, may be destroyed by micro-organisms and the product may thus contain various amounts of dextrose and levulose, not necessarily in equimolecular proportions. Other sugars are also formed during this degradation of sucrose.

Estimations based on the reduction of Fehling's solution express the result as invert sugar, i.e., in terms of an equimolecular mixture of dextrose and levulose. The results will include not only the dextrose and levulose but also any other sugars or non-sugars present which can reduce Fehling's solution. The chromatographic method relies on visual comparison with known standards so that separate determinations of either dextrose or levulose can be made. By using general reagents such as *p*-anisidine[1] all the sugars present in the sample can be shown on one chromatogram. Sugars formed by chemical action, microbial action or heat may be present and, in raw sugars, have been found to increase under long or unsuitable storage conditions. Increases in oligosaccharides[2] may be noted before any significant change occurs in pol readings and "invert sugar" figures, and their presence is an indication of sucrose loss. Again, the presence of the unfermentable reducing sugar allulose[3], seen in chromatograms run from old stored raw cane sugars, and also present in refinery syrups and molasses, is an indication of loss of sucrose. A study of the D/L ratio may also indicate losses.

EXPERIMENTAL.

The method follows broadly the lines described by ALBON and GROSS for the determination of raffinose in raw beet sugars.[4]

Apparatus:

Two solvent tanks were used; one a glass tank as described previously[5] and a second, constructed of polythene, and thermally insulated with expanded rubber board and enclosed in plyboard. The top is covered with a sheet of glass, sliding in a polythene groove, over which fits an insulated plyboard lid. Internal dimensions are 25½ in × 11 in × 23½ in high and the tank is fitted with two polythene solvent troughs so that four chromatograms my be run at the same time. The drying oven[6] and viewing box[4] for even heating and even illumination have been described previously.

Paper.

Whatman No. 1 Chromatographic grade, size 18¼ in × 22½ in.

Solvent Mixture.

n-propanol (lab. reagent)—7 parts by volume
distilled water—2 parts by volume
ethyl acetate (A.R. quality)—1 part by volume.

The reagents are completely miscible and the mixture is used in the troughs and in the tank.

Spraying reagents.

1. α-naphthol (B.D.H., A.R. quality) is used to reveal levulose and other ketose sugars.

A 2% w/v solution in 50% v/v Industrial Methylated Spirits (I.M.S.), to which 10% v/v ortho-phosphoric acid (A.R.) is added immediately prior to spraying, is used. After heating at 85–90°C for approx. 10 minutes the sugar spots appear, blue on a white background.

2. "Genochrome"* the pure form of di-ethyl-para-phenylenediamine sulphite is used in a ½% w/v solution with 50% v/v I.M.S. containing 2½% w/v of phthalic acid. After spraying, the chromatograms are heated for 4 min at 115–120°C to develop the colour. This shows the dextrose and other aldose sugars as brown or reddish brown spots on a white background.

Standards.

Standards are prepared in volumetric flasks from pure sucrose and solutions of (*a*) potassium chloride and (*b*) dextrose plus levulose. Aliquots of the dextrose and levulose solution in increments of not less than 0·05% w/v are added to the standard flasks so that these will contain from 0·04% to 0·60% dextrose and levulose. Using this range, it has been found that the spot intensities show the greatest differences. The sucrose and potassium chloride solution are added in amounts such that the sucrose and salt concentrations are similar to those in the prepared sample. This technique obviates the need to de-ionise the sample. With great dilution or with a low ash sample the potassium chloride solution can be omitted; when the ash concentration is not known it will be found satisfactory to add amounts of potassium chloride equivalent to 0·5% in the standards.

Samples.

The sample solution is prepared so that the dextrose and levulose concentration will come within the limits quoted for the standards. For raw sugar this will be 40% w/v solution, for cane molasses 2½% w/v,

* May and Baker Ltd., Dagenham, Essex.

for raw syrups 10% w/v. If the amount of dextrose and levulose present is unknown or uncertain the sample can be made up at several concentrations so that one solution will give figures within the range of standards.

Procedure.

5 µl spots of the sample(s) and of the standards are placed, 3 cm apart, on the starting line of the Whatman No. 1 paper using a micro pipette. Two sheets are spotted in duplicate so that one can be used for the dextrose determination and the other for the levulose. After the spots are dry, chromatograms are developed in the solvent tanks for about 40 hours at 15–20°C, dried in the oven described, sprayed (using 1 ml to 25 sq. cm.) and heated at the requisite temperature. The α-naphthol papers are placed at once between glass sheets to prevent fading and both chromatograms are "read" through the window in the viewing box.

Results.

To examine the reliability of the method solutions of known dextrose and levulose content were prepared. Results of these tests are quoted in Table 1.

Table I. Analysis of Synthetic Mixtures.

	Test Solution (1)		Test Solution (2)	
	By weight %	By chromatography %	By weight %	By chromatography %
Dextrose	0·208	0·215	0·203	0·196 ± 0·010
Levulose	0·208	0·210	0·200	0·203 ± 0·008
D + L	0·416	0·425	0·403	0·399 ± 0·013
Invert sugar by Lane and Eynon's method		0·41		—

In a series of tests where four samples *A*, *B*, *C* and *D* were examined simultaneously, two sheets were run for dextrose determinations and samples were spotted on in the following positional manner:—

Chromatogram 1.	*A* (iv)	*B*	*C*	*D*	5 Standards	*A* (i)	*B*	*C*	*D*
Chromatogram 2.	*C*	*D*	*A* (ii)	*B*	5 Standards	*C*	*D*	*A* (iii)	*B*

Two sheets were spotted in a similar way for the levulose determination.

This arrangement ensured that the four replicates of each sample appeared once in each possible position in relation to the standards (arranged in ascending order of concentration) and thus randomised as far as possible any positional variation. For instance, sample *A* appears in chromatogram 1 next to the edge of the paper (iv) and next to the standards (i). In chromatogram 2 sample *A* appears two places away from the standards (ii) and three away from the standards (iii). Three assessors read the chromatograms by comparing spot sizes and intensities with the standards so that the result of any one sample for dextrose or levulose was the average of twelve readings. Results from one sample (*A*) of raw sugar are quoted in Table II showing both dextrose and levulose.

Table II. Readings of the 4 Replicates of Sample A.

Position		Dextrose Chromatograms iv	i	ii	iii	Levulose Chromatograms iv	i	ii	iii
		%	%	%	%	%	%	%	%
Assessors	(1)	0·49	0·52	0·39	0·41	0·46	0·44	0·45	0·46
	(2)	0·50	0·51	0·44	0·52	0·51	0·47	0·46	0·49
	(3)	0·49	0·53	0·48	0·44	0·48	0·49	0·48	0·50
Average			0·48%				0·47%		

Statistical analysis of figures obtained in these tests gave a degree of precision of ±10%.

Application Method.

The paper chromatographic method was used in the routine analysis of raw cane sugars and Table III shows results obtained together with invert sugar determinations by the Lane and Eynon method. D/L ratios are quoted and some observations follow on degradation products formed during storage of these sugars. The results (average figures after analysis of 40 samples) before and after storing raw sugars in the British West Indies for 2 months are shown under 1. Results obtained (average figures of 8–22 samples taken) on analysing B.W.I. sugars before and after shipment and before and after bulk storage in England for eleven months are shown under 2. Analyses of Australian sugars stored under unsuitable conditions in England for long periods, in comparison with a typical Australian sugar on arrival in England, are shown under 3.

Table III. Analyses of Various Raw Cane Sugars.

Investigation	By Chromatography D %	L %	D+L %	D/L %	By Lane & Eynon's method Invert sugar %	Degradation Products
1. Before Storage	0·53	0·55	1·08	0·96	1·25	—
After Storage	0·54	0·57	1·11	0·95	1·23	*k*+*a*
2. After shipment	0·57	0·57	1·14	1·00	1·27	—
Before Storage	0·55	0·56	1·11	0·98	1·27	—
After Storage	0·54	0·31	0·85	1·74	0·96	*k* + *a*
3. Normal sample	0·34	0·29	0·63	1·2	0·78	—
After Storage	0·97	0·11	1·08	8·8	1·30	*K* + *A*
	1·5	0·21	1·71	7·1	1·96	*K* + *A*
	0·69	0·14	0·83	4·9	1·00	*K* + *A*
	1·2	0·56	1·76	2·1	1·80	*k* + *a*

N.B.—*k* + *a* denotes small amounts of kestoses and allulose.
K + *A* denotes large amounts of kestoses and allulose.

The figures show the preferential destruction of levulose especially under bad storage conditions, the increase in D/L ratio and the increase in degradation products. Samples examined under 3 showed three slow running ketoses with the same R_f values as those formed by mould invertase.[7] A sugar of the same R_f as that of allulose was also present in these and the other stored sugars. Because of the effect on the Pol readings of kestose[8] and the large D/L ratio it would be difficult to gauge the full extent of sucrose loss in these sugars without the chromatographic determinations.

The method also proved useful in pan boiling experiments[9] to study sucrose loss, where it was shown that there was no preferential destruction of the more heat-labile levulose, the D/L ratio remaining near enough to unity throughout the experiments. Three slow running oligosaccharides, one of which showed reducing properties when using the silver nitrate spraying reagent described by TREVELYAN *et al.*,[10] and a fast running sugar, probably allulose, also showing reducing properties, were present in all samples tested.

Table IV. Analyses of Cane Molasses.

Molasses sample	By Chromatography Dextrose (*D*)	Levulose (*L*) %	*D* + *L* %	*D*/*L*	By Lane & Eynon's method Invert sugar %
1	12·0	9·7	21·7	1·2	23·50
2	12·7	9·8	22·5	1·3	23·39
3	11·8	11·0	22·8	1·1	23·50
4	12·3	11·2	23·5	1·1	23·72
5	11·5	10·3	21·8	1·1	24·29
6	11·2	9·6	20·8	1·2	21·62
7	10·7	10·1	20·8	1·1	22·29
8	10·7	9·4	20·1	1·1	22·10

The results of determination of dextrose and levulose by paper chromatography in cane molasses are shown in Table IV. The fructose anhydrides noted by FOSTER and MARSH[11] were also present in these samples although these tests show a D/L >1 whereas in the Queensland molasses it was <1. The difference between the D + L figure and the invert sugar by the Lane and Eynon method can be accounted [illegible] by the presence of other reducing sugars such [illegible] allulose.

CONCLUSION.

The method described is simple and convenie[illegible] and requires no elaborate or expensive equipme[illegible]. Although the running time is 36–40 hours the actu[illegible] working time involved is short, and, with the dire[illegible] visual comparison of spots, results are very quick[illegible] obtained after development. No de-ionising of sample or elution of sugars is necessary.

Actual figures of dextrose and levulose can be obtained with no interference from other sugars. The degree of precision of the method is ±10%.

The authors wish to thank Mr. H. C. S. DE WHALLEY for his scientific advice and encouragement, P. D. FIFE and R. RUNECKLES for their co-operation and the directors of Tate & Lyle Ltd. for permission to publish this work.

REFERENCES:

1 MUKERJEE and SRISTAVA: *Nature*, 1952, **169**, 330.
2 DE WHALLEY: *I.S.J.*, 1952, **54**, 127.
3 ZERBAN *et al.*: *Sugar*, 1952, **47**, (2), 33 ; SATTLER and ZERBAN: *Ind. Eng. Chem.*, 1945, **37**, 1133.
4 *Analyst*, 1952, **77**, 410.
5 *Ibid.*, 1950, **75**, 454.
6 *Ibid.*, 1952, **77**, 406.
7 BEALING and BACON: *Biochem. J.*, 1953, **53**, 277.
8 DE WHALLEY, *I.S.J.*, 1952, **54**, 127.
9 THOMPSON *et al.*, *Ibid.*, 1957, **59**, 213.
10 *Nature*, 1950, **166**, 445.
11 *I.S.J.*, 1958, **60**, 8.

RECYCLING OF YEAST IN DISTILLERY PRACTICE

By J. P. SHUKLA and B. D. KAPOOR (National Sugar Institute, Kanpur, India.)

IN fermentation by the ordinary batch process there is always a concurrent formation of alcohol and the cellular mass of the yeast. The production of this yeast involves the consumption of 3 to 6% of sugar in the mash. In the fermentation technique devised by F. BOINOT[1] and patented by USINES DE MELLE, Deux-Sevres, France[2], the suppression of this consumption of sugar for yeast growth is aimed at and a corresponding increase in alcohol yield is claimed. Various authors[3,4,5] have supported the claims made by USINES DE MELLE process. In order to obtain this suppression the so-called "specific cellular saturation" of the yeast is maintained constant after it has once been attained. This is achieved by allowing the fermentation to continue until complete, recovering all the yeast that is present in the liquid by centrifuging and using this yeast again for the fermentation of a fresh volume of the mash such that the total resulting volume is equal to that of the first fermentation. The second fermentation revives without any appreciable formation of new yeast cells. Reproduction of the new yeast-cells takes place only to the extent necessary to replace the very small proportion of cells found dead after each fermentation. The process is repeated and can be carried out for a long time. Various other claims have been enumerated[1,5] and as such numerous modern distilleries throughout the world are using the Boinot process.

1 *I.S.J.*, 1939, 466.
2 *I.S.J.*, 1935, **37**, 241. (B.P. 393,082; 420,878; 483,363).
3 J. COURTOIS: *I.S.J.*, 1936, **38**, 355. (*Ind. Sacc. Ital.*, 19[illegible] **29**, 100–102).
4 E. L. A. BRENNAND: *I.S.J.*, 1937, **39**, 112.
5 J. M. LAGOMASINO: *I.S.J.*, 1949, **51**, 338.

The best results are said to be secured when the proportion of yeast circulated does not exceed 10 grams per litre. Obviously, therefore, there should be higher fermentation efficiencies obtained with an inoculum of 10 grams per litre with little formation of yeast as compared with 0·4 grams per litre inoculum used in the batch fermentation process. In the Dansk Gaerings-Industri process[6] a rapid fermentation is secured by seeding the mash at a very high rate of from 25 to 500 g yeast per litre wherein the fermentation time is reduced to about one twentieth of that required for batch fermentation. Here also when the desired degree of fermentation has been attained the yeast is recovered by centrifuging and re-used for seeding another similar fermentation. Here no claim is made for an increased alcohol yield. The question arises as to what agencies, if any, could inhibit proliferation of the living yeast-cells at the specific-cellular concentration advocated by Boinot process. If credence is given to the addition of 'some inhibiting agents' how is the dead part of the yeast cells replaced?

The adoption of the Boinot process in the distilleries in India is of major consequence. In the present paper a comparison has been made as to the yeast formed and efficiencies obtained by using a specific yeast-cell concentration of 10 kg per 1000 litres and 0·4 kg per 1000 litres and sugar balances have been drawn up.

Experimental :

The waste molasses from a sulphitation sugar factory was used, and the dilutions chosen for setting up the worts were the same as are employed in the distilleries. The molasses was clarified by treatment with ammonium sulphate[7]. A pure culture of *Saccharomyces Cerevisiae* I.I.S.T. No. 13 was developed in a clarified molasses solution at a concentration of 8% reducing matter. The yeast sediment was centrifuged, washed twice by centrifuging with sterile distilled water. This was then suspended in water and its pH adjusted to 2·5 with hydrochloric acid[8] and centrifuged after one hour. The sediment was resuspended in sterile water and pH adjusted to 5·0 with caustic potash. This was centrifuged and weighed. A suspension of this purified yeast was made in phosphate buffer of pH 4·8 and requisite volumes of this were added to molasses solutions. The data obtained represent a mean of flasks and estimations carried out in triplicates.

The total reducing matter was determined by Eynon & Lane's[9] method after acid hydrolysis. Alcohol was estimated in distillates by oxidation with potassium dichromate. The yeast formed was centrifuged and washed with distilled water by repeated centrifuging till no more molasses colour was detectable in the supernatant. It was dried at 75°C in vacuum to constant weight.

Table I.

Inoculum used 0·4 g/litre.

Temp. of fermentation 30 ± 0·1°C. Time of fermentation 120 hr

No.	Reducing matter set up in the wort % volume	Alcohol formed % volume	Yeast* formed in g % volume	Residual reducing matter % volume	Fermentation efficiency	Reducing matter unaccounted for % volume
1	7·75	3·71	0·234	0·56	93·68	0·18+
2	8·74	4·31	0·197	0·64	96·42	0·40+
3	9·58	4·53	0·243	0·68	92·54	0·02—
4	10·53	5·15	0·214	0·74	95·72	0·38+
5	11·58	5·65	0·187	0·84	95·43	0·40+
6	12·51	6·22	0·158	0·91	97·33	0·58+
7	13·48	6·54	0·179	0·98	94·92	0·38+

* 0·476 g of sugar is taken to be equivalent to 1 g of yeast[10].

Table II.

Inoculum used 10 g/litre.

Temp. of fermentation 30 ± 0·1°C. Time of fermentation 120 hr.

No.	Reducing matter set up in the wort % volume	Alcohol formed % volume	Yeast* formed in g % volume	Residual reducing matter % volume	Fermentation efficiency	Reducing matter unaccounted for % volume
1	7·84	3·28	0·649	0·49	81·63	0·62—
2	8·72	3·90	0·649	0·57	87·54	0·22—
3	9·71	4·37	0·629	0·69	88·00	0·17—
4	10·31	4·77	0·722	0·74	90·50	0·61+
5	11·54	5·38	0·731	0·80	91·09	0·12+
6	12·64	5·87	0·458	0·95	90·80	0·05+
7	13·5	6·16	0·493	0·98	89·20	0·024–

From the data given above the following conclusions may be arrived at :—

1. The fermentation efficiency is higher with 0·4 g/litre inoculum as compared with 10 g/litre inoculum.

2. The proliferation of yeast is not checked with higher inoculum when the yeast is collected on completion of the fermentation as recommended in the Boinot process.

3. Yeast formed % volume is higher at lower sugar concentration and is suppressed at increased concentration of sugars.

The author's thanks are due to Shri S. N. Gundu Rao, B.Sc., A.H.B.T.I., F.A.Sc., F.R.I.C., Director, National Sugar Institute, for taking keen interest in this work.

[6] B.P. 401,495.
[7] J. P. Shukla and B. D. Kapoor: In Press.
[8] A. Lund: *Brygmesteren No.* 1, p.11, Copenhagen, 1944.
[9] *Java Bulletin* 1931 (5th Ed.), (11), 3333.
[10] J. White and D. J. Munns: Wallerstein *Lab. Comm.*, 1951, (46), 202.

Pilar Sugar Central, Philippines, 1956/57 Report.—From 236,939·437 tons of cane milled during the season, a total of 29,890 tons of 97° pol raw sugar was manufactured. The crop was harvested from 3,965·57 hectares. Damage to the standing cane and juice purity drops were caused by bad weather which included typhoons and rain; high factory losses in addition resulted from entry of muddy cane into the factory. A feature of the Report is the large number of colour photographs.

Copyright reserved by the authors.

THE REMOVAL OF STARCH FROM CANE JUICES

By R. I. NICHOLSON and M. HORSLEY
(Research Department, The Colonial Sugar Refining Co. Ltd., Sydney, Australia).

THE presence of starch in cane juice has been recognised for many years and at the present time certain varieties of cane yield juice with a starch content of 600 p.p.m. or more.

As a result raw sugars are sometimes encountered with starch contents of up to 600–700 p.p.m.

Early workers on starch in cane juices were E. HADDON[1,2,3] and L. FEUILHERADE[4]. More recently R. T. BALCH and associates[5] in Louisiana and J. B. ALEXANDER[6] in South Africa have studied the problem. These authors have stressed the deleterious effects of starch on mill processing and on the quality of raw sugar.

Two approaches have been proposed for the lowering of starch levels. One minimises the entry of starch into juices and the other removes it after entry.

FEUILHERADE states that two patents were issued to HADDON, one dealing with the separation of starch from unheated raw juice by kieselguhr filtration and the other with the removal of starch employing a manufactured amylase called "Ubase".

Most of the methods used against starch are mentioned by R. H. COTTON and associates[7] who processed sorghum for sucrose. They recognised both the prevention of entry into juices as well as the removal.

The conclusions reached by these authors were :

1. Diffusion introduced less starch than crushing.
2. Diffusion temperature should be kept below that of starch gelatinisation.
3. Carbonatation of juices removed more starch than lime defecation.
4. Starch could be removed by enzymatic treatment.

To these methods must be added centrifugation, which is being investigated in South Africa, but which is said to encounter problems from severe sand erosion of the equipment. This paper does not consider the effects of starch, but is limited to a description of a process for its removal.

REMOVAL OF STARCH BY ENZYMES

As mentioned in the previous section, it is 30 year since workers in the sugar industry first proposed the use of manufactured enzymes.

These have not found satisfactory application since they are inefficient in high density syrups particularly if applied after the starch has suffered retrogradation. Their use on juices is technically feasible but uneconomic.

We have established that cane juice contains sufficient naturally occurring enzyme to remove practically all its starch content provided favourable conditions are applied. A study of the properties of cane starch and of the enzyme have shown what these conditions should be and why customary milling processes fail to remove more than a portion of the starch.

PROPERTIES OF CANE STARCH.

This is present in the form of granules which are not available to enzymatic attack. There may be a slow enzymatic attack since BALCH reported that starch slowly disappears in cut, stored cane, but advanced no reason for this. We have confirmed that starch tends to disappear slowly both in stored cane and juice.

Cane starch possesses a gelatinisation temperature of about 70°C and enzymatic attack does not become fully effective until the starch is dispersed. There is some evidence that the dissolution rate of the starch granule is increased when heated in dilute enzyme rather than in enzyme-free solutions.

PROPERTIES OF CANE JUICE AMYLASE.

The enzyme is soluble and appears in whole juice or filtrates. Optimum pH for activity is close to that of unlimed cane juice, viz. pH 5·5—5·7, and drops rapidly at higher pH. It is reasonably heat-stable, being fully active at 60°C. Other considerations may make it desirable to work as high as 70°C where the enzyme is highly active but is losing activity due to heat denaturation. Higher temperatures result in rapid de-activation.

Table 1.

Starch Content and Enzyme Activity of Various Canes.

Cane Variety	Juice Examined	Average Starch Content (p.p.m.)	Average Starch-Destroying Activity
Trojan	1st roller juice	16·8	0.17
Comus	" " "	25·0	0·17
Pindar	" " "	88·0	0·34
Pindar	Nodal juice	115·5	0·62
Q57	1st roller juice	119·0	0·29
Vesta	" " "	148·0	0·42
4OSN/746	" " "	272·0	0·29
CP29/116	" " "	349·0	0·35
CP29/116	" " "	418·0	0·33
CP29/116	" " "	373·0	0·42

[1] *S. African Sugar J.*, 1926, **10**, 629.
[2] *Ibid.*, 1928, **12**, 87.
[3] *Revue Agric.* (Mauritius), 1928, March-April, 80.
[4] *S. African Sugar J.*, 1929, **13**, 305.
[5] *Sugar J.* (La)., 1952, **15**, (11), 39.
[6] *Proc. 28th Congr. S. African Sugar Tech.*, 1954, 100.
[7] *Ind. Eng. Chem.*, 1951, **43**, 628.

Experimental

The unit of enzyme activity is described as milligrams of starch destroyed per minute per millilitre of cane juice at 60°C. It is determined under the following conditions: A well dispersed 1% solution of soluble starch (British Drug Houses) is prepared. A 20 ml. aliquot is heated in a bath maintained at 60°C. A half aliquot (10 ml.) of cane juice filtrate

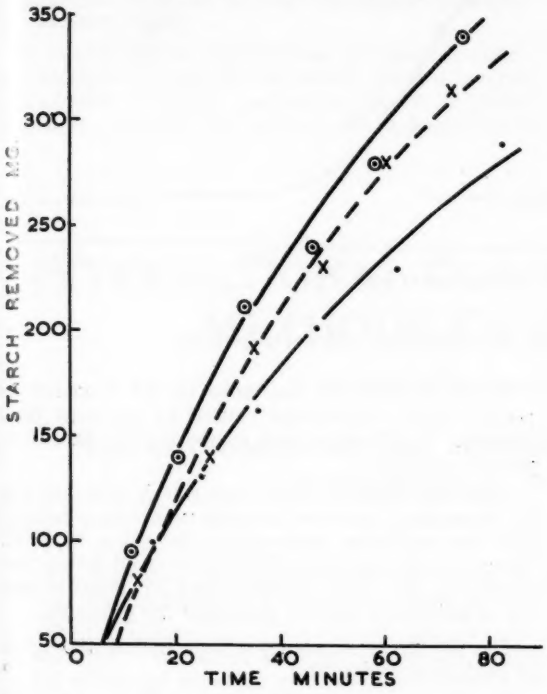


Fig. 1.

Removal of dissolved starch. Effect of temperature ⊙ 60°C. × 65°C · 70°C.

is separately heated to 60°C. A 1 ml. sample of the heated starch solution is withdrawn and pipetted into a 100 ml. volumetric flask and kept for analysis. The residual 19 ml. of starch solution and the 10 ml. of juice are mixed and timing started.

One ml. aliquots are withdrawn at suitable times and pipetted into 20 ml. iodine solution (0·005 N iodine containing 2% concentrated hydrochloric acid). Ten and twenty minutes are suitable times for withdrawal of samples, but this may be varied to suit the activity of the juice.

To obtain similar figures from the two samples they should be taken before substrate depletion has affected the rate. The initial 1 ml. of starch solution is diluted and 20 ml. of iodine solution added and made to volume. The absorbances are read at 700 mμ versus an iodine blank before and after decolorisation of the blue by adding a trace amount of solid metabisulphite to the cuvettes. Results are read on a standard graph derived from soluble starch.

Table 1 shows that the activities of juices vary with cane variety and with their location in the stalk. The activity is highest in nodal zones and the upper part of the stalk.

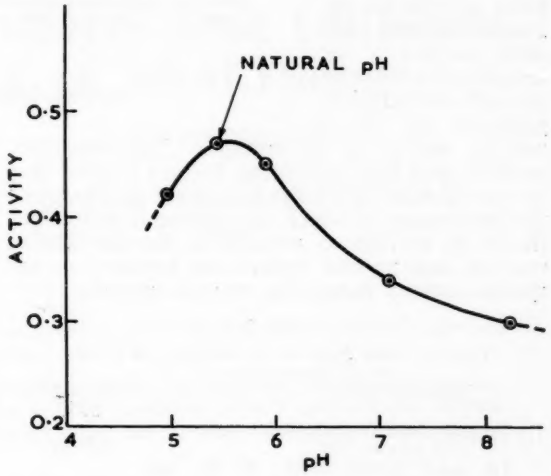


Fig. 2.

Effect of pH on enzyme activity at 60°C.

Figure 1 shows the effect of temperature on starch removal. Three elevated temperatures within a proposed working range are given.

Figure 2 illustrates the effect of pH on enzyme activity at 60°C.

Table 2.

Action of Cane Juice Enzymes on Solutions of Cane Starch at 60°C.

Cane Starch Solution	Enzyme Solution (unheated juice)	Amylase of Unheated Juice	% Unheated Juice in Mixture	Starch Content (mgm./100ml) Initial	After	Time	mg. Starch Removed	% Removal
B9	H10	0·32	10·5	7·95	1·65	20 min.	6·30	79
B9	H10	0·32	20·0	7·10	1·45	15 min.	5·65	80
B9	B9	0·43	11·1	8·66	1·50	34 min.	7·16	83
B9	B9	0·43	17·1	7·16	1·35	30 min.	5·81	81
B9	B9	0·43	10·0	38·00	8·60	28 min.	29·40	77
B9	B9	0·15	10·0	38·00	12·00	38 min.	26·00	68
B10	H11	0·25	11·1	10·40	2·80	25 min.	7·60	73
Reagent Soluble Starch	B9	0·32	11·1	11·30	0·90	17 min.	10·40	92

Table 2 shows the removal of cane starch from mixtures of heated and unheated juices maintained at 60°C.

Examples so far given illustrate enzymatic activity on dispersed starch. For removal of starch from cane juice the starch must first be dispersed by heat followed by the addition of enzyme from unheated juice and the temperature then maintained at a point suitable for enzymatic activity. Another method is the selection of a temperature sufficiently high to gelatinise the starch without destroying the enzyme. The alternative methods have been considered, keeping in mind that the starch must be rendered available to attack and the temperature at which the enzyme is maintained should be as high as possible to increase rate of reaction and prevent undesirable bacterial or enzymatic activity during the retention period.

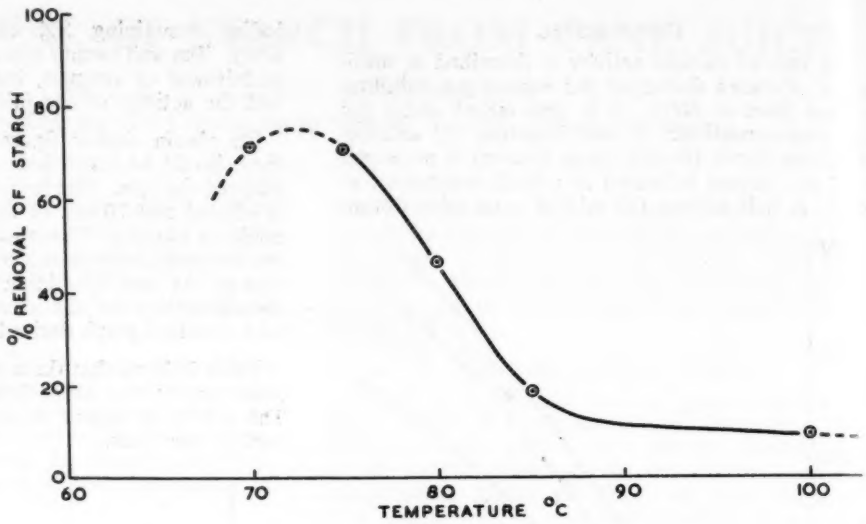


Fig. 3.
Removal of cane starch in granular form. Effect of temperature.

Table 3.

Effect of Cane Juice on the Viscosity of Potato Suspensions.

Treatment	Viscosity at 25°C
1·4 gram potato starch, 40 ml water 15 min at 75°C	263 cP
1·4 gram potato starch, 40 ml cane juice filtrate at 75°C	12·1 cP
Cane juice filtrate alone at 75°C	2·5 cP

The formation of dextran by dextran sucrase activity during incubation was considered particularly undesirable. This enzyme is inactivated above 50°C.

Table 3 illustrates the drop in the viscosity of potato starch suspensions caused by the cane juice enzyme. Suspensions were stirred during the run to prevent settling.

Figure 3 indicates that cane starch granules can be successfully attacked without preliminary heating and that optimum temperature lies close to 70°C. Temperatures higher than 75°C cause rapid destruction of enzyme and lower temperatures fail because they are insufficiently high to gelatinise the granules.

The 60° figure has not yet been included because of analytical difficulties.

The illustration of the existence of an optimum temperature is extended in Table 4. Greater differences in behaviour would have resulted if a more unfavourable temperature than 80°C had been selected.

It is evident that current sugar milling processes fail to remove more than a proportion of the starch

Table 4.

ACTION OF CANE JUICE AMYLASE ON STARCH GRANULES

Rate of Starch Destruction at Favourable and Less Favourable Temperatures.

	Favourable Temperature—70°C Time, min.						Less Favourable Temperature—80°C Time, min.					
	0	10	15	20	22	30	0	10	15	20	22	30
Cane Juice Filtrate (1)	49·7 mg	6·0	2·9	—	1·5	1·0	49·7 mg	21·3	22·2	—	21·5	23·0
+ Starch Granules (potato)	100/ ml											
% Destruction of Starch ..	Nil	87·9	97·1	—	98·5	99·0	Nil	57·1	55·4	—	56·8	53·7
Cane Juice Filtrate (1) Lower Starch Level	19·9 mg	2·8	2·0	—	1·9	1·9	—	—	—	—	—	—
% Destruction of Starch ..	Nil	85·9	90·0	—	90·4	90·4	—	—	—	—	—	—
Cane Juice Filtrate (2) Lower Enzyme Activity....	49·7 mg	15·0	10·4	—	5·3	3·1	49·7 mg	20·4	15·4	—	11·4	9·2
% Destruction of Starch ..	Nil	69·8	79·0	—	89·3	93·7	Nil	58·9	68·9	—	76·1	81·4
Cane Juice Filtrate (3)												
+ Cane Starch Granules ..	94·5 mg	2·7	—	2·3	—	—	94·5 mg	16·2	—	16·9	—	15·5
% Destruction of Starch ..	Nil	97·2	—	97·6	—	—	Nil	82·8	—	82·1	—	83·6

because the existence and properties of the enzyme have not been recognised.

Liming before heating and rapid heating with or without prior liming are inimical to enzyme activity. The requirements for removal of essentially all the starch are an incubation of the juice for a short period at a pH not far removed from the natural pH of the juice, and at a temperature high enough to gelatinise the starch but not high enough to destroy the enzyme rapidly.

In current patent applications we have described two methods of applying the starch removal process. One consists of heating part of the juice to gelatinise the starch, cooling and mixing with unheated juice still containing active enzyme. The other consists of heating all the juice to a temperature near 70°C and holding for a period.

The process requires only equipment for heating and the provision of a suitable retention tank; otherwise no plant alterations are necessary.

The process also brings about a number of desirable changes in the quality of the juice which are claimed in the patent application. These will be discussed in later communications.

ACKNOWLEDGMENT

The authors are grateful to the Management of The Colonial Sugar Refining Company Ltd., Sydney, Australia, for their permission to publish this paper.

INTERNATIONAL COMMISSION FOR UNIFORM METHODS OF SUGAR ANALYSIS

H. C. S. de WHALLEY (President) D. GROSS (Secretary)

List of recommendations adopted at the 12th Session of ICUMSA at Washington, D.C., June 2—6, 1958

The following recommendations were voted on and adopted at the 12th Session by the delegates of the various National Committees affiliated to ICUMSA.

The full official text of the Proceedings comprising the referee reports, original and adopted recommendations, discussions, speeches and group photographs, will be published as a bound volume, copies of which are expected to be available for sale through the usual distribution channels within the next 6—8 months.

Subject 1. Constitution and By-Laws.

Referee : H. C. S. DE WHALLEY.

(1) Amendment to Article 1 of the Constitution :

At any plenary session amendments can be proposed by a member of the Executive Committee and approved for submission to all National Committees for a postal vote.

Subject 2. Weighing, Taring, Sampling and Classification of Raw Sugar.

Referee : A. E. TATE (presented by J. M. HUTSON.)

(1) The recommendations given in the report are to be accepted for information and guidance and are not to be considered as officially adopted.

(2) The item classification is to be eliminated.

Subject 3. Conductimetric and Gravimetric Ash.

Referee : K. SANDERA (presented by H. C. S. DE WHALLEY.)

(1) In countries where, according to the 1954 meeting, the 10% deduction from sulphated ash has been discontinued, the calculation of Nett Rendement = Pol—4·5 ash is suggested for consideration.

(2) Different conductimetric methods for ash determination (concentrations, equations) are to be admitted, according to the decision of the local National Committees, but precise definitions of the recommended methods and equations are necessary in every separate case; the respective factor shall be frequently checked for reliability. The conductimetric methods, which deal with the content of soluble salts (electrolytes), are to be preferred as more expedient and correct than gravimetric methods.

(3) Flame photometry should be used for all cases where determination of K, Na and Ca is of particular importance.

(4) Further study of a wider use of conductimetric methods in laboratory analysis as well as in factory and field control should be encouraged.

(5) DE WHALLEY's proposal that the 10th Session recommendation (2) viz. Double Sulphated Ash, by the Tate and Lyle modification of the A.O.A.C. method, is to be implemented.

Subject 4. Determination of Reducing Sugars in Sugar Products other than Molasses and Refined Sugars.

Referee : EMMA J. MCDONALD.

(1) STRIEGLER's method is to be adopted as tentative.

(2) The uses and advantages of SAILLARD's method are to be studied further.

(3) The LUFF-SCHOORL method is to be studied further, combined with that of LANE & EYNON as a titration method.

(4) Micro-methods suitable for use in automatic analytical devices are to be appraised as to reproducibility and accuracy.

(5) Reaction kinetics of copper reducing sugar methods are to be studied with a preference for low pH methods.

Subject 5. Evaluating Tests for Bone Charcoal.

Referee : E. P. BARRETT.

(1) The title is to be expanded to include other adsorbents.

(2) Column tests are to be retained in preference to batch tests.

(3) Whilst appreciating the contribution by the staff of the Bone Char Research Project Inc., ICUMSA reserves the right of appointing Referee and Associates.

Subject 6. Sucrose and Reducing Sugars in Molasses.

Referee : C. H. ALLEN.

(1) The chemical method with hot or cold invertase inversion (substantially that of the A.O.A.C., as per the British Committee proposal at the 10th Session[1]) is to be adopted tentatively in those countries where no government action is required to change from polarimetric methods.

(2) The effect of lead acetate used in polarimetric methods is to be studied in view of the work of J. G. N. GASKIN.

(3) Use of EDTA and other chelating agents, as alternatives to potassium oxalate for decalcifying molasses test solution, is to be studied further.

(4) The constant volume modification of the LANE & EYNON method is to be studied further.

(5) Low-alkalinity methods (pH 10·5 or lower) are to be studied further.

(6) The effect of oxidation on Cu_2O is to be studied.

Subject 7. Tables of Refractive Indices of Sugar Solutions.

Referee : C. F. SNYDER.

(1) Recommendation regarding modified tables of sucrose is to be postponed until these have been considered by all National Committees.

(2) H.I. WATERMAN'S proposal to initiate a study to develop a system of space models in order to be able to predict physical constants of mixed sugar solutions is to be adopted.

Subject 8. Standardisation of Quartz Control Plates.

Referee : E. EINSPORN (presented by F. BATES)

I.

(1) The clear aperture of the plate is to be at least 10 mm. in diameter.

(2) No defects shall be visible on the surfaces of the plate when examined interferometrically.

(3) The thickness of the plate shall not vary by more than 0·15μ over the whole area of the plate.

(4) Each surface of the plate shall lie between two imaginary parallel planes 0·5μ apart.

(5) The axial play of the plate in its cell must be between 5μ and 30μ.

(6) Squareness of the plate to the axis of the mounting tube should be within 10 angular minutes.

(7) The crystal, including all parts covered by the mounting, should be completely free from all inhomogeneities such as twining, striae, inclusions.

(8) The over-all diameter of the plate must not be smaller than 15 mm., not greater than 17 mm., and at least 4 mm. greater than the clear aperture.

(9) The angle between the optical axis of the plate and that normal to the faces of the plate must be less than 10 minutes.

(10) The combination of all errors must not introduce uncertainty of more than 0·005 angular degree.

(11) Identification mark. If satisfactory in above mentioned respects, the plate should have on its covered edge, and the mounting on all important parts, the following marks engraved: serial number, year, hall mark of the official testing laboratory and the letters I.P.

(12) The optical rotation is to be measured with spectrally filtered green light from a low pressure mercury lamp at a temperature close to 20°C. Temperature and other corrections are to be applied and the rotation converted to sugar degrees of the International Sugar Scale, or to angular degrees for sodium light by following factors :

1 angular degree at 20°C. (λ = 546·1 mμ) = 2·4576° Sugar.

1 angular degree at 20°C. (λ = 546·1 mμ) = 0·85085 angular degree at 20°C. for λ = 589·25 mμ.

II.

(1) A comparison of sets of national plates by interchange with one another is to be carried out. "I.P." plates are to be used.

(2) The rotation of the 100°S-plate for the "Osram" sodium-lamp is to be determined.

(3) Temperature corrections in polarimetry and the advisability of making all calibrations and measurements at one standard temperature (for example, 20°C.) are to be studied.

(4) The design and construction of quartz control plates of low values (0·5° to 15° I.S.S.) and the possible use of other standards of optical rotation, for example magnetic standards for electronic polarimeters, are to be considered.

(5) Further improvements in the design of quartz control plates are to be considered.

Subject 9. Tests for Evaluation of the Refining Qualities of Beet Sugar.

Referee : P. DEVILLERS (presented by R. SAUNIER).

(1) The standard affination method as described in the report is to be adopted, viz. mixing with pure saturated syrup at 20°C., filtration through a sintered "Pyrex" glass filter, rinsing with sugar syrup, then with 70% alcohol saturated with sucrose, with 96% alcohol, and drying.

(2) The method of determining insoluble matter with a micropore membrane filter is to be adopted tentatively.

(3) A study of the methods of analysis of sugar by means of ion-exchange resins is to be undertaken.

(4) Collaborative and comparative analyses of raw sugars is to be carried out by various laboratories from the following points of view : standard affination—fractionation by means of ion-exchange columns, insoluble matter, and decolorization on a char filter.

Subject 10. Tests for the Evaluation of the Refining Qualities of Cane Sugar.

Referee : C. W. DAVIS (presented by R. W. RUTLEDGE.)

(1) Work on the ELLIOTT test along the lines indicated in the referee report is to be continued.

(2) The determination of insoluble matter is to be investigated further, especially by the DOUWES DEKKER method.

(3) The POWERS method for expressing crystal size distribution and uniformity is to be adopted tentatively, and a comparison made with other methods.

Subject 11. Specifications and Tolerances for Pure Sucrose and Reagents.

Referee : J. HENRY (presented by W. W. BINKLEY).

Pure Sucrose.

(1) Material is to contain not more than 0·004% sulphated ash and 0·004% reducing sugars (as invert).

(2) It is to be prepared preferably from cane rather than from beet sources.

[1] *Proc. 10th Session ICUMSA*, 1949, 15.

(3) If beet sources are used for pure sucrose preparation, tests by chromatography are to show a content of raffinose not exceeding 0·004%.

(4) Total water content is to be obtained by drying the finely-ground sucrose for 1 hour at 105°C. and cooling in an air-cooled desiccator for 90 minutes, or in a desiccator provided with a water-cooled copper block for 20 minutes.

(5) The % of sucrose in the sample is to be calculated by deducting [sulphated ash + organic matter (ash × 1·5) + water + reducing sugars + raffinose (if present)] from 100.

Basic lead acetate.

(1) Basic lead acetate solution, prepared as per 1954 recommendation, is to contain between 9·5 and 10·5 g basic lead calculated as PbO per 100 ml.

(2) The dry lead specification is to contain additional clauses:

(a) Total lead (as PbO) not less than 75%, and

(b) Water content not more than 1·5%.

Invert Sugar.

(1) The preparation of standard invert sugar solution is to be formulated and in the meantime

(a) The method of EYNON is to be adopted tentatively.

(b) The method of the A.O.A.C. is to be adopted tentatively.

Iron.

The content of iron in pure copper sulphate solution is to be studied.

Pure Dextrose.

The purity of dextrose is to be discussed to ascertain whether further action is necessary.

Invertase.

Work is to be carried out on standardisation of invertase and suitability of analytical and commercial preparations.

Subject 12. Tests for the Evaluation of the Crystallising Qualities of Refinery Liquors.

Referee : A. VANHOOK.

(1) The title is to be changed to : Sugar Liquors and Syrups.

(2) The degree of Supersaturation S, is (a) to be defined for practical usage as :

$$S = \frac{\text{Ratio of Sugar/Water}}{\text{Ratio of Sugar/Water at the same temperature and True Purity in Saturated Solution}}$$

and (b) to be extended for research purposes by further study of a formula defining S as the same ratio but at a constant Non-Sucrose/Water ratio.

(3) KUCHARENKO's crystallization velocity data for pure sucrose solutions are to be adopted as standards of comparison, but to temperatures of 50°C. only. Further work is desirable above this level.

(4) Efforts are to be made to reduce the time required for the simplified test described in previous reports, and single crystal measurements is to be reconsidered in this regard.

(5) Further exploitation of crystallization studies at the practical level is to be encouraged.

Subject 13. Colour and Turbidity of Sugar Products.

Referee : T. R. GILLETT.

(1) The basis for the specification of sugar colour is to be the visual appearance to the human eye.

(2) The spectrophotometer is to be recognized as the basic instrument in the characterization of colour.

(3) When computing tri-stimulus colour specifications from spectrophotometric data, the standard observer and co-ordinate system adopted in 1931 by the International Commission on Illumination is to be used. Standard C.I.E. illuminant C, representative of average daylight, is to be used as the illuminant in these computations.

(4) The following nomenclature is to be used when results of spectrophotometric absorption measurements on sugar solutions are reported :

(a) *Transmittance.*

(1) Let I_1 represent the radiant energy incident upon the first surface of the sample.

(2) Let I_2 represent the radiant energy leaving the second surface of the sample.

(3) Then $T = I_2/I_1$ = *transmittance* of the sample. (100 T = percentage transmittance).

(b) *Transmittancy.*

(1) Let T_{soln} represent the transmittance of a given cell containing the solution.

(2) Let T_{solv} represent the transmittance of the same or a duplicate cell containing the pure solvent, or the same mixture in the same relative proportions minus the constituent of interest.

(3) Then $T_s = T_{soln}/T_{solv}$ = *transmittancy* of the solution. ($100T_s$ = percentage transmittancy).

(c) *Absorbancy.*

$A_s = -\log_{10} T_s$ = *absorbancy* of solution.

(d) *Absorbancy Index.*

(1) Let b represent the length in cm of the absorbing path between the boundary layers of the solution.

(2) Let c represent the concentration in grammes per ml of the solution as determined refractometrically and converted to density units by reference to standard tables.

(3) Then absorbancy index is defined as :

$$a_s = \frac{A_s}{bc} = \text{absorbancy index of solution.}$$

(4) For granulated sugars and other products having small values of a_s, it is convenient to multiply the absorbancy index by 1000.

The above concepts are strictly correct when no radiant energy is scattered from the initial direction of propagation. In other words, the term "absorbancy index" applies only to optically clear or non-scattering solutions. Where light scattering is present, the following terminology applies, and in order to avoid ambiguity, "absorbancy index" should not be used.

(e) †*Attenuancy.*

$A^*_c = -\log T_s$ = *Attenuancy* of solution.

In the absence of light scattering, the attenuancy (A^*_c) is equal to the absorbancy (A_s). In the absence of absorption, the attenuancy is a measure of scattering.

(f) †*Attenuation Index.*

(1) $a^*_c = \frac{A^*_c}{bc}$ = *Attenuation Index*

(2) For granulated sugars and other products having small values of a^*_c, it is convenient to multiply the attenuation index by 1000.

† (e) & (f) *are to be further studied and the instrument is to be specified.*

(5) For routine colour measurements requiring speed and accuracy, a colorimeter of adequate sensitivity and reliability is to be used.

(6) For routine colour measurements, a good-quality distilled water is to be used to adjust the solids concentration of high density products and to dissolve solid sugars.

(7) For research purposes, a high-quality granulated sugar solution, as specified in the Appendix of the referee report, is to be used for diluting the colour of products too dark to be measured without dilution.

(8) A cell thickness of 10 cm preferably is to be used for photoelectric measurements of white sugar solutions.

(9) For darker products, for which necessary dilution is to be made according to 6 & 7, a cell length is to be selected which will give a reading between 20 and 80% transmittancy on the instrument scale.

(10) All colour measurements are to be calculated on a basis of unit concentration of 1 gramme per ml and unit thickness of 1 cm.

(11) Methods for measuring turbidity and reflectance of solid sugars are to be investigated further.

(12) Solution colour methods 1, 1–A, 1–B, 2, 3, 4 and 5, appended to the referee report, are to be studied further.

(13) A study is to be made of the effects of pH and density on colour measurements in order to develop standard procedures.

(14) Filtration techniques in connection with colour determinations are to be studied.

Subject 14. Values of the Clerget Divisor and Methods of Multiple Polarization for Sucrose and Raffinose.

Referee : J. DUBOURG (presented by EMMA J. MCDONALD).

(1) Determination by multiple polarization is to employ preferably hydrolysis by enzymes, owing to their specific action (invertase methods for products derived from cane, the PAINE & BALCH method for products derived from beet). In default, acid hydrolysis may be used (JACKSON & GILLIS' method IV for products derived from cane, the OSBORN & ZISCH method for products derived from beet).

(2) In JACKSON & GILLIS' method IV at 60°, the time of heating after 3 minutes agitation is to be extended to 10 minutes.

(3) To avoid any temperature correction, all polarizations are to be carried out at 20°C., if possible.

Subject 15. Dry Substance (total solids) in Sugar Products by Drying, Refractive Index and Other Methods.

Referee : S. D. GARDINER (presented by D. HIBBERT).

(1) The Tate and Lyle Standard Vacuum Oven Method, involving 5 hr heating at 70°C and using a Precision Vacuum Oven of the type described by GARDINER and FARMILOE (ref. 1 in report), is to be adopted tentatively as a standard reference method for the determination of solids in molasses (cane and beet).

(2) The Refractometer Solids Method (sucrose tables), corrected for Invert Sugar and Sulphate Ash or Sulphate Ash constituents, is to be studied as a quick alternative method to (1). Grain in molasses to be removed by sufficient dilution with distilled water.

(3) The determination of water (whether surface moisture or internal water in refined sugars or raw sugars) by the following methods is to be studied :

(a) the method of GARDINER and KEYTE using cobaltous bromide in chloroform, (b) the carbide and infra-red heat ray method of SARANIN, (c) the infra-red heat ray method of NISHIKI, (d) the high temperature oven method of NAGAGHARA and TSUTSUMI, (e) the nuclear magnetic resonance method, (f) the infra red method with dry solvents, (g) the vacuum distillation method of HILL and DOBBS.

(4) The solution factor method is to be revised, using solids determined by the vacuum oven method in (1) and determining ash corrections for density of 25% solutions of sucrose and mixtures of sucrose and invert.

Subject 16. pH of Sugar Products.

Referee : D. GROSS.

(1) The electrometric determination of pH, using an electrode system consisting of a glass electrode and a calomel reference electrode with a saturated KCl-solution salt bridge and standard buffer solutions as per (2) at a temperature of 20°C. or 28°C., is to be adopted as the official method for sugar products.

(2) The three N.B.S. buffer solutions as shown in Table II of the referee report are to be adopted as pH reference solutions for the temperature range 20° to 60°C.

(3) The pH/temperature relationship is to be studied by collaborative tests on a wider variety of sugar products and in widely varying geographical areas.

Subject 17. Analysis and Evaluation of Refined Sugars.

Referee : G. P. MEADE.

(1) As water determination is a complex problem on which further work is essential, search for a simple rapid method, especially for surface moisture, reliable in the hands of a routine analyst, is to be pursued diligently. (*VIDE* Subject 15)

(2) Standardization of the following details of the atmospheric drying method seems advisable and is to be considered: sample not to be ground; at least 20 grammes to be dried at 105°C. for not more than 3 hours, possibly for a shorter period. (Drying to constant weight or for extended periods introduces losses by inversion or destruction of sucrose. Extreme care in cooling dried samples before weighing is essential. Vacuum drying at 70°C and about 10 cm absolute pressure requires similar precautions except that the drying period can be much longer—16 to 18 hours).

(3) *Grist Test*. The MA and CV method of reporting (POWERS' method) is to be studied further. A screening method for very fine powdered sugars is to be developed.

(4) *Floc Test*. Further study is to be made of suitable standard methods.

(5) *Odour*. Further study is to be made of suitable methods of determining odour.

(6) *Invert Sugar*. Although DE WHALLEY's method for invert sugar in refined sugars has been adopted, other methods with a wider range, especially for such materials as high-test liquors and liquid sugars, such as the tetrazolium method and accelerated methods are to be investigated.

Subject 18. Design and Standardization of Laboratory Apparatus.

No report submitted.

Subject 19. Viscosity and Surface Tension of Sugar Solutions.

Referee : H. I. WATERMAN.

(1) For sugar-containing solutions the formula

$$\log v = \frac{A}{T^x} + B$$

is to be adopted.

If the kinematic viscosity (v) in centistokes is known at three temperatures T_1, T_2 and T_3, the constants A, B, and x of the equation can be calculated. The viscosity at any other temperature can then be predicted.

(2) The method of BREITUNG which makes use of a characterization factor for thick juices and beet molasses is to be investigated. (The dry substance is to be obtained by drying).

(3) The viscosity-temperature diagram of BREITUNG is to be considered in relation to the viscosity-temperature formula mentioned under (1).

Subject 20. Not on the Agenda.

Subject 21. Polarization of Raw Sugars and Lead Error.

Referee : J. G. N. GASKIN.

(1) The polarization of a raw sugar, whether cane or beet, should be the result obtained when the sugar is examined by a defined method and that such polarization should be named "ICUMSA Polarization" and should be so recorded.

(2) A defined method such as that described in the appendix to the referee report is to be studied further with a view to adoption.

Subject 22. Raffinose, Other Oligosaccharides and Glycosides.

Referee : A. CARRUTHERS.

(1) (a) The method of ALBON and GROSS as described for use with raw sugar is to be applied for all beet products. (b) As

an alternative, the method of DE WHALLEY may be used for molasses. (c) Chromatographic elution methods are to be studied.

(2) The double enzyme method of PAINE and BALCH is to be regarded as alternative.

(3) No further studies are to be made of the OSBORN & ZISCH method. As reasonable agreement has been found for some samples of molasses between the results of paper chromatography and those obtained by single acid hydrolysis, using the HERZFELD–SCHREFELD procedure and the WORTMANN formula, this method should receive further study.

Subject 23. Determination of Sugar in Sugar Beets.

Referee : H. HIRSCHMÜLLER.

(1) Whenever possible, samples are to be drawn from cossettes. If otherwise, no fewer than 50 beets are to be used for sampling.

(2) The use of pulp (brei) saws is to be recommended. The amount of pulp (brei) is to be approximately one tenth of the amount of beet. Further studies are to be undertaken with a view to improving and standardizing the types of pulp(brei) saws now in use.

(3) For practical sugar determination in beet, hot digestion is to be used. Alternatively, cold digestion is to be used on very fine pulp.

(4) For cold digestion, blenders are to be used. A study is to be undertaken to improve and standardize the types of blenders available.

(5) Studies are to be made to improve the methods for estimating the real value of the juice volume and to investigate the variations of the juice volume.

(6) The method of aqueous extraction advocated by WESTESSON, the method of double extraction according to the British Sub-Committee, and the isotope dilution method recommended by HIRSCHMÜLLER and HORNING, are to be checked for their suitability for use as reference methods.

(7) Efforts to work out an exact, no matter how complicated, scientific method of determining sugar in beet, suited to evaluate with certainty the reliability of the various methods now in use, are to be continued.

Subject 24. Determination of Factors causing Deterioration of Raw and Refined Sugars in Storage and Transport.

Referee : H. E. C. POWERS.

(1) Equilibrium or Equivalent Relative Humidity (E.R.H.) is to be adopted tentatively as a primary measure of the vulnerability of sugars.

(2) Bulk density measurement is to be adopted tentatively:

(a) in the laboratory using the method of G. P. MEADE, (b) in the factory or refinery, by the Plaistow Refinery method which is to receive further study, and (c) by the γ–ray method suggested by S. HILL.

(3) "Hardness of set" determination by the DOUWES DEKKER method is to be adopted tentatively.

(4) "Angle of slip" measurement by the Danish Sugar Co. method is to be adopted tentatively.

(5) (a) The rate of moisture migration under varying conditions is to be studied further. (b) The relationship between E.R.H. and microbiological activity is to be studied further.

Subject 25. Inorganic Constituents of Sugars and Sugar Products.

Referee : R. SAUNIER.

(1) Research on and testing of methods of the highest possible sensitivity and precision for the analytical determination of inorganic impurities in sugars and sugar products is to be continued and also their development for routine control in factory practice.

(2) For the determination of lead, in accordance with the proposals of the British National Sub-Committee:

(a) the "wet ashing" procedures for low-grade liquid sugar products is to be adopted;

(b) the possible adoption of these procedures for solid low-grade sugar products is to be studied;

(c) the possible adoption of the sulphate ashing method for application of liquid and solid low-grade sugar products is to be studied.

(3) The determination of iron by the orthophenanthroline method, which has been studied and applied in the laboratory of the Syndicat National des Fabricants de Sucre de France, is to be adopted tentatively.

(4) The determination of alkali metals and alkaline-earth metals by flame photometry, taking into account reservations and precautions suggested in regard to the mode of operation, is to be adopted.

(5) The study of the determination of SO_2 and other sulphur-containing compounds in sugar products to be continued. The method adapted by the laboratory of the Syndicat National des Fabricants de Sucre de France for the determination in white sugars is to be examined for tentative adoption.

Subject 26. Starch Hydrolysates.

Referee : K. HEYNS (presented by D. LANGLOIS).

(1) The method, described by PATTERSON and SAVAGE (*Analyst*, 1957, **82**, 812), is to be adopted tentatively for the determination of dextrose and maltose in starch hydrolysis products.

(2) The conditions for the extension of this method to the determination of maltotriose are to be studied.

(3) The determination of dry substance by means of the specific gravity of a w/v solution and an appropriate ash correction are to be studied.

(4) An abstract of the U.S. Committee report is to be included in the *Proceedings*.

Subject 27. Organic Constituents of Sugars and Sugar Products.

Referee : P. HONIG.

(1) Methods for the determination of the following organic constituents of sugars and sugar products are to be studied:

(*A*) Organic acids, subdivided into

1. nitrogen-containing organic acids (amino acids).
2. nitrogen-free organic acids.

(*B*) Polysaccharides, subdivided into :

1. neutral polysaccharides (starch, dextran, araban, galactan, levan).
2. acidic polysaccharides (pectins).

(*C*) Lipids (fatty acids, oils, fats and phosphatides).

(*D*) Saponins.

(*E*) Betaine.

(2) A review of the current literature on this subject to be included in the next referee report.

Subject 28. Microbiological Counts in Raw and Refined Cane Sugars.

Referee : I. R. SHERWOOD
(presented by R. WEIDENHAGEN).

For recommendations see Subject 29.

Subject 29. Microbiological Counts in Raw and Refined Beet Sugars.

Referee : R. WEIDENHAGEN.

(1) Subjects 28 and 29 are to be combined to constitute a single subject entitled "Determination of Micro-Organisms in Sugar Products".

(2) The standardization of media for different organisms, with particular reference to pH and incubation temperature, is to be studied further.

(3) Membrane filter methods are to be studied further.

(4) Phase contrast techniques are to be studied further.

(5) Statistical examination of results is to be investigated.

SUGAR-HOUSE PRACTICE

Novel Method of Levelling Cane Feed. J. A. ACOSTA. *Sugar y Azúcar*, 1957, **52,** (10), 29.—In order to level cane feed to the mills at Fellsmere two sets of knives rotating in opposite directions were installed, the second set revolving against the flow of cane, throwing it straight backward. Thus the cane comes into contact with the knives twice, and even a third time as it is knocked against the hood and falls onto the knives. The flow of cane may be guided to either side of the conveyor by placing a deflector plate on edge under the hood at about 45° across the conveyor with the end where the cane usually accumulates nearer to the cane knives. The shredded cane is thrown by the knives against the plate and bounces off at an angle, falling on the far side of the carrier.

* * *

Progress in Thailand. J. C. P. CHEN. *Sugar y Azúcar*, 1957, **52,** (10), 30–32.—The Thailand sugar industry is reviewed with an account of the expansion in production by construction of 11 new factories. The sudden interest in modernization has sprung from a realization of the extent of the losses when crushing in a single three-roller mill instead of a tandem, together with the savings possible if Thailand became self-sufficient in sugar.

* * *

Thermal Conditions in a White Sugar Silo. E. KALHAUGE. *Sucr. Belge*, 1957, 77, 97–104.—The influence of the daily and annual changes in atmospheric temperature on the sugar stored in silos and of the temperature of the sugar itself is discussed with the aid of formulae and graphs. The effect of various types of wall on temperature difference within the sugar is considered, and it is concluded that a prestressed concrete wall is better than one of sheet metal, which requires lining for heat insulation and more maintenance than the former. In view of the difficulties of maintaining constant temperature and R.H. within the silo, the author recommends a system of heating from the walls and floor at a constant temperature, combined with automatic drying of the air above the sugar, which latter is practised on its own in Danish and German concrete silos. It is also recommended that sugars entering the silo should have a moisture content of 0·03–0·06% and that the temperature within the silo should not exceed 30–40°C.

* * *

Imperial Completes Bulk Raw Sugar Installation. ANON. *Sugar y Azúcar*, 1957, **52,** (11), 29–30.—Raw sugar for the Imperial Sugar Co. is unloaded at Galveston pier by grabs which unload ships at 50 tons/hr per hold and feed the sugar to five permanent hoppers which feed a 400-ft belt conveyor, a 2-oz sample being extracted by a rotating mechanical arm every ½ minute. Sugar passes via the other conveyors to 4 boxcars which are loaded simultaneously using "slingers" (6 loading simultaneously is planned for the future). At the refinery, the sugar is pushed from the boxcars by "Payloaders" into an underground hopper which either feeds to process or sends excess sugar by conveyor to the top of a 40-million pound capacity warehouse where a shuttle conveyor ensures even stacking around the walls. Sugar is reclaimed from the warehouse by an underground tunnel running the length of the warehouse and having hoppers which feed conveyors. Bulldozers are used to push the sugar into the tunnel when clearing the warehouse.

* * *

The Williamson Clarification Process. H. I. KNOWLES. *Proc. 4th Tech. Session Bone Char*, 1955, 5–21.—The original Williamson clarification process is described together with the modifications of the original clarifier and technique. The Bulkley-Dunton clarifier is also described; this can operate at the rate of 226 gallons/min, though operational difficulties have arisen, attributed in part to the inflexibility of the design. When operating satisfactorily, liquor clarity compares favourably with that from a Jacobs clarifier and the clarifier capacity per sq. ft. floor space is much greater. Normal scum produced is 2–3% by weight of clear liquor, increasing to 10–12% with raws difficult to clarify. In a discussion of experiments with a laboratory clarifier the surface area of floc is mentioned; it is pointed out that increased surface area may improve clarification, but there is need of confirmation.

* * *

Phosphate Defeeation Combined with Press Filtration. F. W. SCHWER and G. W. MULLER. *Proc. 4th Tech. Session Bone Char*, 1955, 23–40.—Laboratory experiments using a bomb filter were made to study the effect on flow rate, liquor colour and ash content of defecation with varying amounts of phosphoric acid at various temperatures, the order in which the defecants should be added, the ageing times of the defecants and the type of filter aid. Tabulated results show that there must be sufficient press capacity to allow for the reduced throughput caused by the lime-phosphate defecation; that at least 0·005% P_2O_5 on solids should be used (0·007% is recommended); that the temperature should be 180–190°F (82–88°C); that there must be sufficient time for floc development for efficient decolorizing (particularly at low dosage); that good pH control is necessary; and that the order of adding reagents is not important, provided that the two are not pre-mixed. In the tests no significant amount of ash was removed from the liquor.

The New Automatic Affination Station at Savannah Sugar Refinery. W. A. CLARNO. *Proc. 4th Tech. Session Bone Char*, 1955, 41–52.—The affination station and its operation are described with diagrams. Sugar is fed into the mingler from a fully-automatic Servo-Balans scale, each dump (of about 2500 lb) actuating a syrup doser, so that a measured amount of syrup at 60°C accompanies the sugar into the mingler. Average retention time in the mingler is 6 min, an adjustable weir at the discharge end controlling the level of the magma, which is discharged to two 450 cu. ft. mixers each supplying 15—1200 r.p.m. centrifugals. Magma level in the mixers is automatically controlled, and also controls the magma supply scrolls and the raw sugar supply to the scale. The curing time in the centrifugals is automatically controlled, a maximum period being allowed according to the demand on the melt liquor. In the event of a drop in the supply of material, a level control cuts out two centrifugals at a time until full stoppage. The centrifugals discharge directly to two U-shaped 810 cu. ft. pre-melters, in which the mixture is retained for ½ hr. A controlled dose of sweetwater is added to the melter as each centrifugal discharges. The liquor goes via a coarse screen and the vapour melter to a final melter where an automatic bubble-type control adjusts the final liquor Brix to 70°. The mixture is then screened and passes to the process plant. As a result of the controls, the melt liquor is of high quality and gives higher yields of washed raw sugar with less sucrose solids for recovery.

* * *

Factors affecting the Properties of Carbonatation Slurries. A. M. HERTZBERG, C. B. MOUNTFORT, G. RUSH and E. W. CUNEEN. *Proc. 4th Tech. Session Bone Char*, 1955, 53–86.—Three sets of pilot plant experiments were carried out in a study of the effects of operating conditions on filtrability, ash and colour removal, and flue gas requirements in the continuous carbonatation of raw melt liquor. Sugars of poor, medium and good filtering properties were used. It was shown that the main factors affecting the filtrability of the carbonatated liquor were: lime dosage, viscosity of the liquor, and the proportion of lime precipitated in the first tank ("degree of carbonatation"). Filtrability improved with increasing lime dosage up to 0·8% CaO on solids, 0·4% CaO sufficing in the case of the better sugars. Recirculation increased filtrability by 25%, but pre-liming to 0·04 and 0·01% followed by 1 hour's retention before carbonatation reduced filtrability. The resistance to filtration by the carbonatated liquor was roughly proportional to the square of the viscosity, other factors being equal. The optimum "degree of carbonatation" was generally 75%, but satisfactory liquors were possible from the better sugars at 90%. Colour removal increased with lime dosage, but was offset by reducing sugar destruction. Average ash elimination was roughly 0·02% (dry solids basis) when no reducing sugar was destroyed. A nomogram gives the safe conditions of temperature, contact time, alkalinity and initial reducing sugar concentration such that there is no change of ash content during carbonatation. An increase in ash was inevitable if more than 0·05% reducing sugar (dry solids basis) were destroyed. Flue gas requirements (10–12% CO_2 by vol.) were least when the smallest fraction of lime was neutralized at the lowest pH and increased roughly in proportion to the viscosity of the liquor in the carbonatation tanks. Control of viscosity and of "degree of carbonatation" is essential. Factory trials confirmed the results of these tests; application of the same methods led to a four-fold increase in the filter station performance.

* * *

Operational Experience with the Plaistow Wharf (Stordy) Char Kiln. J. D. ATKINSON and G. W. PAYNE. *Proc. 4th Tech. Session Bone Char*, 1955, 87–100.—Modifications are described which have been made to the char kiln described earlier[1]. These include changes in the stoker and combustion chamber to obtain a higher CO_2 content in the combustion products and to minimize the ill-effects of very high combustion chamber temperatures. Steps have also been taken to overcome blockages in the driers (with consequent fires). Further minor modifications, including those to the retort section and to the heat exchanger, are described. The performance of the kiln is uniformly good; the colour of the caustic soda extract of the char is low, while the water extract pH is 8·8–8·9.

* * *

The Oil-Fired Herreshoff Char Kiln at Liverpool. J. G. FAIRRIE. *Proc. Tech. Session Bone Char*, 1955, 101–159.—Modifications of the Nichols-Herreshoff gas-fired kiln, previously discussed,[2] for operation with fuel oil, are described in detail with diagrams. The throughput was increased from 3 to 8·25 tons dry char/hr and thermal performance improved by providing a direct contact louvre predrier heated by air from an enlarged air-cooler which replaced the original water cooler. Experiments were carried out with two fuels, Gas Oil and "Britoleum", the specifications of which are given. Results of 2½ hr tests using these two fuels as well as coal and town gas are compared and show that "Britoleum" was the most economical. Temperatures in the oil-fired kiln were generally higher than those in a gas-fired kiln due to an increased rate of heat input; this caused high stack and radiation losses. At 8·25 tons/hr dry char, retention time of the char on the 7 hearths of the kiln was 25–30 min, the overall revivification taking 45·5–50·5 min. No ill-effects arose from oil-firing; an increase in calcium sulphate from about 0·8% to about 1·2% did not affect the quality of the char, the carbon content of which remained at 12%. After 21 months, having been kept at constant carbon of 12%, the char was found to have a decolorizing power 50% better than the stock char. Where the carbon content was maintained at optimum level, dust formation was much higher than with the retort kilns (where it is 0·22%), being 0·51% in the

[1] *I.S.J.*, 1953, **55**, 152.
[2] *I.S.J.*, 1951, **53**, 259; *see also I.S.J.*, 1950, **52**, 36.

case of revivified char and 0·68% with new char; but no spent char was rejected, as in the retort kilns, where an average of 0·35% on char burnt is rejected. Full results of the operating tests are given.

* * *

Bulk Density as a Control Factor in Char Activity. L. G. JOYNER and H. L. HOFFMAN. *Proc. 4th Tech. Session Bone Char*, 1955, 161–184.—The two char houses at the Reserve refinery of Godchaux Sugars, Inc. were originally operated in series, new char being added to one house and the spent char being removed from the other, the make-up in the low-grade house being transferred from the high-grade house stock. In 1950 this was changed to a parallel operation in which spent char was removed and new char added as make-up to both houses. As a result, there was an expected fall in the char density in the original low-grade house, but there was no corresponding increase in char colour removal. Despite an increase in the colour load, there was no increase in char consumption. The inter-relationship of bulk density, surface area and colour removal was investigated, eliminating the complicating factor of particle size by using closely-sieved fractions. It is emphasized that char decolorizing efficiency may be increased by decreasing the bulk density.

* * *

Preliminary Design Study for a Bone Char Dryer. D. A. COLKER. *Proc. 4th Tech. Session Bone Char*, 1955, 185–192.—An account is given of preliminary experiments carried out by the National Drying Machinery Corp. of Philadelphia, together with a proposed apron-type conveyor dryer for further small-scale tests.

* * *

Plant Scale Evaluation of "Synthad C-38". N. L. PENNINGTON, C. W. BEAL, W. D. HEATH and D. L. MORRISON. *Proc. 4th Tech. Session Bone Char*, 1955, 195–215, 237–246.—"Synthad" and service bone char were compared at Crockett refinery on a basis of colour and ash removal at varying flow rates and raw sugar blends; physical and chemical properties and regeneration characteristics. "Synthad" has good colour and ash removal properties and most of its physical properties are equal or superior to the bone char. Effluents off "Synthad" have low pH, however, and its regeneration rate is unsatisfactory, possibly due to higher moisture retention. It is concluded that "Synthad" cannot be used at present to replace bone char at Crockett.

* * *

Developments in Control of the Properties of "Synthad". E. P. BARRETT, M. MALANCHUCK and R. S. BOWMAN. *Proc. 4th Tech. Session Bone Char*, 1955, 217–246.—In accordance with the experience of users of the original "Synthad", it has been decided to modify the original product somewhat so as to diminish its total pore volume and to lower the temperature required for its regeneration. Properties of the original and modified "Synthad" are compared.

Purification of Clarified Sugar Cane Juices and Quality of Sugar Produced by Ion-Exchange. B. A. SMITH, C. A. FORT and L. F. MARTIN. *Proc. 4th Tech. Session Bone Char*, 1955, 267–280.—Pilot-plant reverse-cycle ion-exchange purification of freshly clarified juices, which is an extension of previously reported work[1], is discussed and results are tabulated. A strongly basic anion exchanger is followed by a weakly acidic cation exchanger, the third exchanger (a "scavenger") being a mixture of weakly and strongly basic anion exchange resins. Three different anion exchangers were compared as well as various "scavenger" exchangers and results of non-sugars, colour and nitrogen elimination, etc., are given. A blend of 1st, 2nd and 3rd sugars boiled from the treated syrup was almost as good as char-refined granulated sugar and contained 93 p.p.m. ash, had a purity of 99.98%, a colour of 3·5 transmittance units, and a turbidity of 32 transmittance units. The final molasses has more than double the reducing substances content of blackstrap molasses (53·5% and 26·1% respectively), but had only 31·9% true sucrose content (compared with 44·5% in blackstrap), and had less carbonate ash, organic non-sugars, and nitrogen.

* * *

Some Properties of Thermophilic Bacteria encountered in Sugar for Canners' Use. C. W. BOHRER. *Proc. 4th Tech. Session Bone Char*, 1955, 281–297.—The basis of the bacterial standards for sugar used in the canning industry is reviewed. The types of organisms and their resistance to heat, chemicals, ultraviolet and γ-rays, are discussed.

* * *

Volume Shrinkage of Mixtures of Multi-Sized Granular Materials. F. G. CARPENTER. *Proc. 4th Tech. Session Bone Char*, 1955, 327–346.—A correlation between volume shrinkage (the decrease in bulk volume caused by the compacting of particles of various sizes) and particle size distributions of granular materials is derived from theoretical considerations and empirically using one-, two-, three- and multiple-component mixtures. The volume shrinkage of glass and alundum spheres and various fractions of service bone chars was determined experimentally. Practical implications of the correlation are discussed.

* * *

The Influence of the Purities of C-Strikes, Final Molasses and C-Sugar on Factory Capacity. M. HEIDERLIJK. *Rev. Agric. Sucr. Rhum. Antilles franç.* 1957, **11**, 65–67.—The relationship between the dry solids content of a *C*-massecuite and the sugar and molasses obtained from it in terms of apparent purity is calculated and illustrated by means of graphs drawn from the formulae. Massecuite quantity to give a fixed quality of molasses and fixed sugar purity is recommended as a useful guide to factory capacity. Problems of molasses exhaustion and the effect of clarification method are discussed.

[1] *I.S.J.*, 1953, **55**, 212.

Properties and Behaviour of Frozen Beet in Sugar Production. *Zucker*, 1957, **10**, 471–478.—The article by F. SCHNEIDER[1] is discussed and an apparatus described by A. V. BRIEGHEL-MÜLLER for determination of pectin in beet; 90% alcohol is added to raw juice at the rate of approximately 75 ml per 10 min through a capillary tube. A measured amount of kieselguhr is added to the raw juice in the beaker (25 ml) and stirred for 15 min. After 1 hr settling time the precipitated mud volume is measured. A graph shows the effect of alcohol concentration on the volume of the muds, constant values being obtained with 60% alcohol by weight upwards. The amount of scum from diffusion juices from healthy beet was found to increase in weight and volume at higher diffusion temperature, while that from deteriorated beet was smaller in volume and very compact. The weight of the lime precipitate from diffusion juice from healthy beet roughly corresponded to the sum of the $CaCO_3$ precipitate and the alcohol precipitate; with deteriorated beet about half the latter remains dissolved in the carbonatated juice. Raw dextran was added to pure sugar solutions and these later defecated and carbonatated. Alcohol precipitation produced a sugar solution fermented with *leuconostoc*. With 3·7 and 1 g dextran per litre of 15% sugar solution, the viscosity remained practically unaltered, whereas with discontinuous carbonatation the solution became decidedly viscous. Determination of the amount of dextran in solution showed that most is separated, probably in the form of a complex compound. Continuous carbonatation destroys this, so that almost all the dextran is redissolved after final carbonatation.

* * *

The Effect of Weather on Sugar Beet Harvest, Storage and Processing. H. D. WALLENSTEIN. *Zeitsch. Zuckerind.*, 1957, **82**, 535–539.—The effect of adverse weather conditions on beet is discussed and the conditions which have prevailed during the last three months of each year from 1907 tabulated. Early harvesting and start of campaign coupled with a shorter campaign are suggested as methods of solving the problem of deteriorated beet, while the need for good firm storage places and of adequate protection against sharp frost is underlined. It is suggested from data suppled that the present-day beet varieties are not as resistant as those of 30–50 years ago.

* * *

Drying and Briquetting of Pulp and Other Fodder in the Sugar Industry. K. CÍHAL and K. CIZ. *Listy Cukr.*, 1957, **73**, 249–255.—The technology of the drying process is reviewed and the equipment used is discussed. Methods of beet pulp analysis are described with 59 references to the literature.

Chemistry of 2nd (Final) Carbonatation. K. CÍHAL. *Listy Cukr.*, 1957, **73**, 255–258.—A review with 20 references to the literature.

* * *

Formula for Determining Sugar in Pulp and Pulp-Press Water. Z. ZAREBA. *Gaz. Cukr.*, 1957, **59**, 297–299.—The measurement of sugar in exhausted cossettes and in pulp-press water is discussed and a formula developed for calculation of these amounts when return water is used for processing. A calculation is made of the amounts of sugar present in the various media by way of example. (The percentages of sugar in pulp and diffusion water when fresh water is used are given as 0·42 and 0·15 respectively, while the corresponding amounts when return water is used are 0·822 and 0·551.) Analytical figures are tabulated to show sugar percentages in these media throughout nine battery diffusion cycles.

* * *

Proprietary Materials for Acceleration of First Carbonatation Thickening. N. D. HILL and F. G. EIS. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 495–498.—An evaluation of "Kelgum", a sodium alginate product of Kelco Co., as a settling aid was made in a series of tests in which other filter aids were also used. The aids were dispersed in water at a concentration of 0·1% and were added to factory 1st carbonatation juice at 1–5 p.p.m. Two p.p.m. was found to be the optimal rate of addition for all aids under normal conditions, but "Aerofloc 548" at 4 p.p.m. was the only aid to produce a clear effluent from carbonatation juice when the clarifier overflow was cloudy due to excess mud introduced with the beet. "Kelgum" and "Aerofloc 548" gave the greatest thickening capacity (34·9 and 34·6 lb solids/sq. ft./hr respectively at 2 p.p.m.), while the capacity with "Lytron X 886" was only slightly greater that that when no filter aid was used. After 1 hr contact time in the Dorr thickener "Kelgum" and "Aerofloc" caused slight increases in thickening capacity while "Lytron X 886" gave an equivalent decrease. Complete dispersion of the aids is essential for maximum efficiency; this is readily achieved using hot water.

* * *

Experiments on Beet Lifters. H. VON HÜLST, H. GÖHLICH and B. SÖCHTING. *Zucker*, 1957, **10**, 535–538.—Investigations carried out on damage caused to beet by lifters are described. The forces needed to pull out the beets are numerous and determination of the beet's breaking-point is difficult, even where the diameter is small.

[1] *I.S.J.*, 1958, **60**, 173.

New Books and Bulletins

Sugarcane (*Saccharum officinarum L.*): **Origin, Classification, Characteristics and Descriptions of Representative Clones.** E. ARTSCHWAGER and E. W. BRANDES. 307 pp; 6 × 9¼ in. Agric. Handbook No. 122. (U.S. Dept. of Agriculture, Washington, D.C., U.S.A.). 1958. Price: $1·25.

Until 1853, when the French annexed New Caledonia, cane cultivation was limited to the relatively few varieties, or clones, which were found in actual cultivation in those Eastern territories where the plant appeared to be indigenous. Thereafter, a series of expeditions visited that vast tract, designated Melanesia, with growing concentration on New Guinea. As a cumulative result of the information gathered, the former idea of two loci of origin, one in New Guinea where arose *S. officinarum*, and the other approximately at the head of the Bay of Bengal whence came the thin canes of N. India, *S. barberi* and *S. sinense*, has given place to one of a single locus in New Guinea. It is of interest, 30 years later, to read[1] the hesitations on this matter of origin expressed at the time of E. W. BRANDES' return from his expedition to New Guinea. On that expedition the discovery was made, as forecast by him, of the new species, *S. robustum*. Since that date, further expeditions have added to our knowledge of the vast array of wild and "garden" forms of both *S. robustum* and *S. officinarum*. The Handbook gives a masterly introductory summary, by E. W. BRANDES (35 pp.), of the evidence bearing on the origin of *S. officinarum* together with the most recent interpretations of that origin. This summary is worthy of close study. Briefly, the view of C. O. GRASSL[2] is accepted; this places *S. robustum* and *Erianthus maximus* Brongn. as the putative ancestors of *S. officinarum*. From a centre in New Guinea, two main lines of migration have been followed; the first, initiated about 8000 B.C., extended eastwards to New Caledonia and, later, continued East and North, through Fiji and Tahiti to the Marquesas and Hawaii. The second migration, commencing about 6000 B.C., took a westerly course through Borneo, Malaya and Burma to India and the Gangetic plain. In the course of that migration it met *S. spontaneum* in its many forms and hence were derived those thin canes characteristic of Northern India on which the specific titles of *S. barberi* and *S. sinense* have been conferred by JESWIET. Behind the interpretation given is marshalled a mass of information, morphological, taxonomical, cytological and pathological.

The second section (37 pp.) of the Handbook is the work of the late E. ARTSCHWAGER and describes in considerable detail and with profuse illustration the vegetative characters on which is based the third section (71 pp.) giving descriptions of approx. 250 Melanesian, Polynesian and Indonesian clones collected at Canal Point, Florida, U.S.A.

* * *

Sugar from Scarcity to Surplus. H. EDSON. 224 pp., 5½ × 8½ in. (Chemical Publishing Co., Inc., 212 Fifth Avenue, New York, N.Y., U.S.A.) 1958. Price : $5·00.

This book is an account of the career of the author between 1888 and 1950 which reads as easily as many a novel and starts as dramatically with an account of the shooting of Mr. EDSON by a negro gambler. The story traces developments over six decades in Louisiana, Cuba, Haiti and San Domingo and recounts how the author started as an untrained laboratory assistant with the U.S. Dept. of Agriculture through the influence of his uncle, Dr. H. W. WILEY, Chief Chemist of the Department. After initial work on the extraction of sugar from sorghum, he was loaned to Calumet sugar factory in Louisiana and thence went for a short time to Hawaii. After returning, his career was spent in Louisiana and the Caribbean area where his activities as chemist, manager and consultant are vividly described. The book will be of interest both from the technical aspect, since it describes from personal knowledge the equipment and processes used 60 years and more ago ; and from the economic aspect, as a result of the description given of the financing and economic development of sugar projects in which the author was concerned.

* * *

Proceedings of the Ninth Congress of the International Society of Sugar Cane Technologists, Vol. I. lxii + 1205 pp; 6×9½ in. (Executive Committee of the I.S.S.C.T., New Delhi, India). 1956.

The first volume of the Proceedings contains the Author Index for the Agricultural Section of the Congress; Committees of the Congress; a membership list; Regional Vice-Chairman; Chairmen's addresses and texts of papers presented to the Agriculture, Soil, Cane Breeding, Entomology and Pathology sections. A revised list is given of sugar cane diseases and their world distribution.

---

[1] *I.S.J.*, 1928, **30**, 518.
[2] *Arnold Arboretum J.*, 1946, **27**, 234–252.

LABORATORY METHODS AND CHEMICAL REPORTS

The Possible Substitution of Enzymatic Inversion for Chemical Inversion in the Determination of Sucrose. J. CHEREL-TOUCHEFEU and J. TAVERNIER. *Annales Technol. Agric.*, 1957, **6**, 103–111; through *S.I.A.*, 1957, **19**, Abstr. 865.—From experiments on sucrose inversion by invertase (Merck or La Rapidase), and the influence of admixtures of glucose and fructose, it is concluded that enzymatic inversion does not yield quantitative results, and that only acid inversion, with subsequent polarimetry and chemical analysis (by the Bertrand method) is suitable. Invertase inversion tests on apple juice were also unsuccessful.

* * *

Ferricyanide and a Modified Periodate Chromatographic Spray for Reducing and Non-Reducing Sugars. D. F. MOWERY. *Anal. Chem.*, 1957, **29**, 1560–1561; through *S.I.A.*, 1957, **19**, Abstr. 870.—The addition of $\geq$25% by volume of tertiary butyl alcohol to aqueous sodium periodate solution as spraying reagent reduces the spread of chromatogram spots in the detection of reducing and/or non-reducing sugars. When a benzidine spray is used after the periodate spray, carbohydrates appear as white or yellow spots on a blue background; with benzidine after a ferricyanide spray, only reducing sugars (white spots on blue) are detected. The periodate spray consists of sodium metaperiodate (0·03 mole) in 750 ml of water, to which 250 ml of *tert.*-butyl alcohol are added. The spray is applied to both sides of the chromatogram (25 ml/sq. ft.) which is dried for 30 min at room temperature and then sprayed with the benzidine reagent. The ferricyanide reagent consists of potassium ferricyanide (0·008 mole) and trisodium phosphate (0·002 mole) dissolved in a mixture of 750 ml of water and 250 ml of *tert.*-butyl alcohol. The spray is used in the same way as the periodate spray, and the chromatogram is dried at 80–90° for 5 min. The benzidine spray consists of benzidine (0·03 mole) in 500 ml of *tert.*-butyl alcohol; this solution is mixed with 0·6 mole solution of ammonium nitrate in 500 ml of water. All three sprays are stable for up to 6 months. The sprays have been used successfully in combination with the usual chromatogram developing reagents. A table is given showing the lower detectable concentration limits of the sugars tested with the various reagents. Using the ferricyanide spray and then the benzidine spray, fructose and glucose were detected at $>0{\cdot}5\gamma$ and $0{\cdot}5\gamma$ concentrations respectively and with the periodate-benzidine combination the limit for both sugars was $0{\cdot}5\gamma$ concentration.

* * *

Microdetermination of Levulose with the Phenol Reagent. E. M. LIVINGSTONE, R. K. MAURMEYER and A. WORTHMAN. *Microchem., J.* 1957, **1**, 261–264; through *J. Sci. Food Agric. Abs.*, 1958, **9**, i 336.—The green colour produced on heating levulose with phenol and conc. H_2SO_4 is measured. The levulose solution (containing 0·5 to 3 mg) is evaporated to dryness *in vacuo* over H_2SO_4. To the residue are added 0·02 ml of phenol solution (10·5% in glacial acetic acid) and 0·06 ml of H_2SO_4 (1 vol. of conc. + 9 vol. of glacial acetic acid) and the tube heated in a boiling water-bath for 9 $\pm$ 1 min with shaking and then cooled under the tap for 1 min. The mixture is made up to 25 ml with glacial acetic acid and the extinction read at 326 mμ, with glacial acetic as a blank. BEER's law is followed with pure levulose, but in presence of other sugars a calibration curve is necessary. Water in any form leads to low results.

* * *

Determination of Iron in Sugar Juices. H. DELAVIER. *Zeitsch. Zuckerind.*, 1957, **82**, 495–496.—Details are given of a modification of the TÖDT method of determining iron in sugar juices previously described[1]. To 25 ml of raw juice are added 10 ml conc. HCl and 5 ml saturated $KMnO_4$ solution and the mixture made up to 100 ml in a flask and filtered. Three drops of H_2O_2 and 10 ml of 10% ammonium thiocyanate are added to 25 or 50 ml of the filtrate according to iron content, and this made up to 100 ml. The colorimetric measurement is then made and the extinction coefficient converted into mg Fe/litre from a calibration curve. The accuracy of this method is $\pm$6%.

* * *

Influence of Inorganic and Organic Compounds on Viscosity (of Sugar Solutions). Z. FRIMLOVA and A. MIRCEV. *Listy Cukr.*, 1957, **75**, 220–225.—Investigations were carried out on changes in viscosity at 20–70°C of 70°Bx sucrose solutions by addition of various compounds in such amounts as to give a Brix of 71°, 72° and 75° at purities of 95·3, 90·7 and 77·8 respectively. Some determinations were made on solutions of 61° and 62°Bx made up from 60°Bx sucrose solutions. Viscosity reduction by NH_4Cl, KBr, and KCl was greater in that order, with greater effects at 70°Bx than at 60°Bx. The viscosity of pure sucrose solutions decreased more rapidly with increasing temperature than that of solutions containing the salts, so that at a sufficiently high temperature the viscosity of the pure sucrose solutions will be the same as that of the salt-containing solutions. The addition of NaOH, Na_2CO_3, NaCl, KOH, K_2CO_3, $CaCl_2$, $Ca(NO_3)_2$, potassium glutamate, raffinose, sucrose, glucose and betaine caused an increase in viscosity, NaOH and Na_2CO_3 causing the greatest increase. The basic salts had greater effect than the neutral salts and sodium compounds had a greater effect than potassium compounds. The calcium compounds caused a considerable increase in viscosity, but as the Ca^{++} ion is strongly hydrophilic, the concentration of the solution is increased and crystallization readily takes place as a result. The organic

[1] *I.S.J.*, 1956, **58**, 259.

substances had little effect on viscosity, the slight increase being very little different to that caused by sucrose addition. The sugars other than sucrose increased the viscosity in proportion to their mol. wt., the raffinose having the greatest effect. All effects were greatest at 20°C and decreased with increasing temperature. Some relationship was found between the viscosity change and the melassegenic power of the compound.

* * *

Method of Growing Sucrose Crystals under Laboratory Conditions. A. A. GERASIMENKO, P. V. GOLOVIN and M. A. ABRAMOVA. *Sakhar. Prom.*, 1957, (11), 71.—About ½ litre of sugar solution containing 72–73% pure sucrose is left in a 1-litre wide-necked conical flask at room temperature for 5–6 days, after which regular crystals <0·1 g in weight are removed with a wooden spatula, washed in absolute alcohol, and stored. They are then grown to 0·4–0·8 g by suspending by silk thread in solutions containing 68·3–68·8% pure sucrose in 50 ml flasks at room temperature for 10–14 days. (A more concentrated solution would cause beading on the crystal and would easily crystallize). They are then held in steel spring clips and immersed in a sucrose solution for 10–12 hr, washed in absolute alcohol, wrapped in parchment paper, and kept in a desiccator. The resultant crystal has highly-polished faces.

* * *

Palatinose (6-[α-Glucopyranosido]-Fructofuranose), a New Bacterial Conversion Product of Sucrose. R. WEIDENHAGEN and S. LORENZ. *Zeitsch. Zuckerind.*, 1957, **82**, 533–534.—A species of bacillus isolated from beet wash water which appears singly or in pairs and apparently forms no endospores, gave a metabolism product which yielded a spot just above sucrose on a paper chromatogram. The organism is mesophilic, forming a dark red substance and an easily detected gas which increases when sucrose is added to the nutrient substrate. The chromatogram spot intensified as the sucrose faded. The substance crystallized out of moist methanol, also out of water and pyridine, in platelets with 1 mol of water of crystallization. It is a reducing disaccharide, with specific rotation of α_D^{20} (in water) + 97·2°, and it was shown to be α-glucosido-6-fructofuranose. This sugar is only slightly sweet compared with sucrose and is very stable to acids (and thus difficult to hydrolyse), exhibiting no mutarotation. The name "palatinose" has been suggested rather than "isomaltose" according to earlier nomenclature.

* * *

Decolorizing Ion-Exchange Resins. III. Evaluation of Decolorizing Properties. J. STAMBERG and O. FILIP. *Listy Cukr.*, 1957, **73**, 243–248.—The decolorizing capacity of various ion-exchange resins was determined by a dynamic method, in which the volume of filtrate and colour are determined at different flow rates through the column, and by a static method, where the resin is mixed with a molasses solution (mixed with kieselguhr and filtered) and the colour of the solution determined periodically. The former method is less suitable for laboratory tests, but is better for comparing different regeneration methods. Results were expressed either as percentage of colour removal (the more suitable) or as amount of coloured bodies adsorbed (per gram or ml of the exchange resin). The best results were obtained with "Asmit 224", followed by "Ionex 1a" (a Czechoslovak resin), W 291, "Decolorite", Ionex 5a" and lastly "Wolfatit E", though there was little difference between the results for the last two mentioned.

* * *

Application of Flame Photometry to the Determination of Lime Salts in Sugar Juices and Products. J. SZULC. *Gaz. Cukr.*, 1957, **59**, 282–285.—The Zeiss Model III flame photometer is described and illustrated and a comparison made with the Schuhknecht & Weibel instrument. A Rantenberg & Knippenberg spray apparatus introduces acetylene as fuel into the atomized test solution. Ca determinations, made at the start and end of the campaign, in thin and thick juice and in massecuites are compared with results obtained by the classic chemical methods. The photometric method has an accuracy of ±2·51%, while its sensitivity is 10^{-3} mole/litre. Adaptation of the photometer for continuous control of thin juices involves addition of a pH meter and cooling vessel to the other apparatus.

* * *

Critical Studies of Cane Juice Analysis. S. C. SEN. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 50–60.—A temperature correction table has been prepared for densities of 0–30°Bx at 0–35°C and 40°C using a hydrometer corrected at 20°C and a standard juice of 15°Bx. Temperature of the juice at the time of Brix determination may be considerably different from that when determining the pol after lead acetate clarification. The effect of temperature on pol measurement is considered negligible for routine analysis purposes, but the effect on Brix is considerable; hence the Brix density should be corrected to the standard temperature before calculating apparent purity. A modified Schmitz table for sucrose and purity coefficient calculation from Brix and pol reading has been prepared and sample pages are given.

* * *

Determination of Ash by Ion-Exchange. I. A Rapid Method of Estimation of Ash in Molasses. S. MUKHERJEE. **II. A Rapid Method of Estimation of Ash in Clarified Cane Juice. III. A Rapid Method of Estimation of Ash in Liquid Glucose.** A. K. CHATTERJEE and S. MUKHERJEE. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 83–89, 243–245.—

I. An ion-exchange method of ash determination was tested by treating 100 c.c. solutions of molasses with various cation exchange resins (about 30 g per 8-inch column); the effluent from the washed columns was made up to 500 c.c., of which 50 c.c. was titrated against 0·1*N* NaOH solution to end-point pH 7·0. The following formula was developed:

$$Y = 0{\cdot}09072\,X - 1{\cdot}35$$

where Y = sulphated ash per 100 g molasses (100°Bx) and X = ml of *N* acid per 100 g molasses. Results are tabulated and compared with those obtained by the standard method. The difference in ash % 100 g molasses varies from —0·61 to ±0·99 for 13 factories in different parts of India and using various methods of clarification.

II. The ash in clarified juice was determined as above, but using the following formula :

$$Y = 0{\cdot}06552\,X + 1{\cdot}38$$

where Y = sulphated ash per 100 ml juice (100°Bx) and X = ml of *N* acid per 100 ml juice. Tabulated results from 12 readings are compared with results obtained by the standard method and show a difference in ash % 100 ml juice varying from —0·61 to +0·40.

III. The following formula was derived for determination of ash in liquid glucose :

$$Y = 0{\cdot}69\,X + 0{\cdot}1081$$

where Y = sulphated ash per 100 ml glucose solution (100°Bx) and X = ml *N* acid produced per 100 ml glucose solution of 100°Bx. Differences in the determination using the standard method and using the ion-exchange method ranged from +0·12 to —0·10.

* * *

Microbiological Examination of Indian Sugars. J. P. SHUKLA and K. A. PRABHU. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 115–125.—Microbial infection in sugars is reviewed and various methods of control are described. Steaming the syrups reduced the number of mesophiles to within the limit laid down by the National Canners' Standards, while treating in an autoclave reduced both mesophiles and thermophiles to the Standards' level. Treatment with ion-exchange resins and with active carbon (more effective than the resins) reduces the number of bacteria, while kieselguhr, "Hyflocel", and cotton wool have no effect. Treatment with ultra-violet radiation for 3 min reduced the mesophiles and thermophiles to the Standards' level. It was found that mesophiles are more susceptible to u.-v. light, the flat sour type of bacteria being resistant and requiring longer exposure.

* * *

A few Observations on the Use of Colouring Matter in Standardisation of Active Carbons. S. K. D. AGARWAL. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 129–136.—Samples of caramel obtained by heating sugar in the solid state or in solution in the presence of alkali were examined colorimetrically at 400-600 mμ to test its suitability for evaluating active carbon. The colour density was also measured after ½ hr reflux with buffer solutions at various pH values. Results, tabulated and illustrated graphically, show that the colour is very dependent on pH. The optical density of the caramels obtained by heating sugar in solid state decreased at pH 6-8 and increased sharply from pH 8 to pH 10, while the caramels prepared by the other method showed a gradual colour increase, which was very slight from pH 8 to pH 10. Reflux up to 5-6 hr caused increase in colour, but no further changes were effected by refluxing for ½ hr after this.

* * *

The Electron Micrographs of the Nipple-like Protuberances on the Cleavage Faces of Sugar Crystals. M. KAMODA and T. YAMANE. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 143–148.—Nipple-like protuberances having a layer structure were found on the cleavage faces of sucrose crystals when these were examined under the electron microscope. Crystal Candy Sugar, Coarse Crystal Superior, and non-deformed single crystals were used in the study. The hemispherical projections were not observed on the faces of the last-named, but were present in large numbers on the faces of the commercial sugar crystals, their sizes ranging from 0·13 to 5·0 μ. They lay along the edges of the stepped structure of the crystal. It is suggested that a connexion exists between the projections and the internal water found to exist in sugar crystals, and that the internal water dissolves the sucrose molecules around it and dries up to form the projections when the carbon replicas are prepared for the electron microscope by condensing carbon vapour in a high vacuum. There is no evidence of the existence of these protuberances before the crystal is prepared for the electron micrograph.

* * *

Automatic Juice Sampling Arrangement for Cane Quality Scheme. R. C. SHARMA. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 207–211.—An automatic juice sampling device is described and illustrated. It comprises a disc mounted on the cane carrier driving shaft and having a lever and pin corresponding to one of a number of equidistant holes around the circumference of a second weighted disc, which is mounted on a shaft parallel to that bearing the first disc. At the other end of this second shaft is a third disc, and an electro-magnet. When the cane reaches the end of the horizontal plane of the carrier, an operator presses a button to energise the magnet, which attracts the third disc and thus the second disc; the pin on the first disc then engages with a hole in the second so that these rotate at the same speed. The time taken by the cane to cover the distance between carrier and 1st mill (or crusher) corresponds to ½ revolution of the second disc, which actuates three micro-switches during one revolution. These operate the electric motor of a turntable carrying the juice containers. When the first switch operates, screened juice rinses off juice from a previous sample and goes to the primary juice tank while a new sample container is brought into position; when the second operates, juice is directed by chute into the new container, and the third switch breaks the magnet circuit and the cycle is completed. The apparatus is to be used during the next crushing season.

BY-PRODUCTS

Composition of Sugar Cane Wax. V. V. MHASKAR and A. B. KULKARNI. *J. Sci. Ind. Res.*, 1957, **16***B*, 374–375; through *S.I.A.*, 1957, **19**, Abstr. 851.—Crude cane wax from cane variety Co 419 (at Ravalgaon Sugar Farm) has been analysed by saponification, separation of unsaponifiable matter, and chromatography, on neutral alumina, of the methyl esters of the fatty acids. The fatty acids comprised 54·7% of normal fatty acids and 21·3% of hydroxy fatty acids. The normal acids contained 5·2% of oleic acid, 2% of linoleic acid, 24·5% of C_{14} to C_{24} (mainly C_{18}) acids and 68·2% of C_{30} to C_{36} acids. Only very small amounts of C_{20} and C_{22} were present. Purification of the hydroxy-acids gave a component acid of m.p. 95–96°C., equiv. wt. 462, acetate m.p. 75–76°C. Analysis of the unsaponifiable matter led to identification of sigmasterol and sitosterol among the 17·1% of sterols, with 2·7% of hydrocarbons and 32·1% of normal fatty alchols; the major fraction of the long-chain alcohols was myricyl alcohol.

* * *

Mycological Formation of Fat. IV. The Component Fatty Acids of the Fats Produced by *Penicillium Soppii* Zal. J. SINGH, S. E. PHILIP, and T. K. WALKER. *J. Sci. Food Agric.*, 1957, **8**, 697–701.—The fat produced by *Penicillium soppii* grown in surface culture on a medium containing sucrose and mineral salts was found to have a low content of free acid (0·6% as oleic acid) and on analysis proved to contain: myristic acid, 0·3%; palmitic, 22·0%; stearic, 7·6%; arachidic, 0·9%; hexadecenoic, 3·3%; oleic, 45·2%; linoleic, 20·0%; linolenic, 0·3%; and eicosenoic acid, 0·4% (w/w). In its content of linoleic acid the fat resembles groundnut oil.

* * *

Fuel Economy in Distillation Factories by Utilization of Spent Wash. J. P. SHUKLA and V. S. RAMAN. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 248–251.—A reduction in steam requirements of a distillery is claimed for a proposed technique whereby the beer column is replaced by a quadruple effect evaporator and a double effect is installed between the rectifying and the dehydration columns. The feed undergoes heat exchange with the spent lees from the rectifying column and is concentrated to 60° Bx in the quadruple effect evaporator, and the concentrated wash is then used as boiler fuel. The condensates from the 2nd and 3rd effect calandrias are further heated and sent as feed to the rectifying column, while the condensate from the 4th effect calandria, possibly containing traces of alcohol, is used to set up the worts in the main fermenters. Potash recovery may be increased by raising the spent wash Brix to 72°. A flowsheet and calculations based on an original mash density of 6°Bx are given, from which it is shown that the steam consumption will be only 13·5 lb for one gallon of 99·5% absolute alcohol by volume from 135 lb of feed containing 6% alcohol by weight. This compares with 35·5 lb using the standard method.

Cattle Fodder with Yeast. J. P. SHUKLA and K. A. PRABHU. *Proc. 25th Conv. Indian Sugar Tech. Assoc.*, 1957, 297–304.—The feeding of molasses to cattle is reviewed and the production of fodder yeast discussed. Tests made with molasses inoculated with various yeasts are described. The highest wet yeast yield (61% on sugar) and the highest nitrogen consumption (58·7 mg %) were obtained with a culture of *Torula utilis* var major, which was therefore used in fodder preparation for experimental feeding to milch cattle.

* * *

Raw Sugar in Fattening Swine. C. B. SINGLETARY, K. G. COULSON, and G. L. ROBERTSON. *Sugar Molecule*, 1957, **10**, (4), 17–20.—Experiments were carried out on feeding raw sugar to pigs of about 60 lb in weight, which were fed rations containing 10, 20, and 30% raw sugar in place of corn until they weighed 200 lb. It was found that those fed the 20% raw sugar showed the greatest daily gain and used the feed more efficiently. The levels of sugar did not affect the thickness of back fat, nor did they greatly affect carcass quality and cut-out values. Comparative data are given.

* * *

Laboratory Preparation of Sucrose Octa-Acetate and its use as a Plasticizer in Rubber Compounds. C. A. LEE. *Taiwan Sugar*, 1957, **4**, (10), 17–20.—Sucrose octa-acetate is prepared in the laboratory by heating 100 g of sugar with 250 g of acetic anhydride and 5 g of pyridine at 130–140°C for 40–50 min. The mixture is then poured into water and neutralized with 2*N* NH_4OH, the resultant precipitate being treated with ether after separation of the solution, which is added again after the treatment. The mixture is stood overnight for evaporation of the ether. The precipitated sucrose octa-acetate is filtered, washed, and dried. 28 g of sodium acetate may be used as catalyst, the heating time then being 30 min, after which the anhydride is distilled off. For commercial production NaOH is used for neutralization and the octa-acetate is purified by precipitating from alcohol solution by addition of water. Tests were made on the plasticizing effect of sucrose octa-acetate, when it was found that the quality of the rubber compounds depreciated, due, it is suggested, to the crystal property of the compound. Tests are to be made on the use of sucrose maleate as a plasticizer.

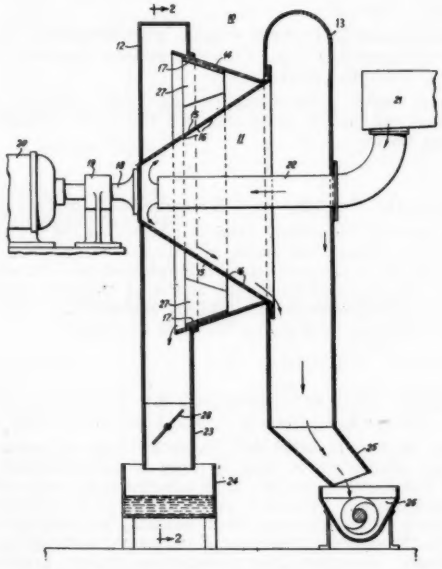
* * *

The Mechanical Depithing of Sugarcane Bagasse. A. G. KELLER. *Sugar J.* (La)., 1957, **20**, (7), 23–32, 36.—The use of bagasse for pulp production and the methods of de-pithing and dirt removal to improve its quality for paper-making are surveyed. The machine and process patented by P. M. HORTON and A. G. KELLER[1] and installed at the Audubon sugar factory of Louisiana State University are described. The economics of bagasse utilization and depithing are examined in detail.

[1] *I.S.J.*, 1957, **59**, 134.

UNITED KINGDOM

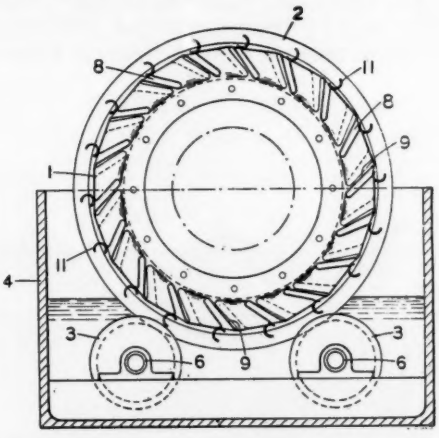
Centrifugal for Continuous Sugar Drying. HEPWORTH MACHINE CO. INC., of Long Island City, N.Y., U.S.A. **794,949.** 9th August 1956; 14th May 1958.—A cone-type continuous centrifugal is fed with massecuite through pipe 22 and the crystals separated from mother-liquor through the screen 16. It is impractical to have an adjustable angle to the cone for operation with varying grades of massecuite but a similar effect



is obtained by mounting blower vanes 27 on the outside of the cone. On rotation these have the effect of causing a reduced pressure outside the cone and giving the effect of a wider-angle cone. By throttling the air-flow by means of valve 28, the effect of the vanes is much reduced, so that adjustment of the valve gives the effect of varying the angle of the cone.

* * *

Heat Treatment of Fine and Granulated Materials. DUNFORD & ELLIOTT PROCESS ENGINEERING LTD., of London S.W.8. **795,231.** 8th February 1955; 21st May 1958.—Channels 8 which run along the side of a drum 1 are not parallel to the axis of rotation of the drum but dip at one end so that, as the drum revolves, cooling or heating liquid, picked up from tank 4 by the high end of a channel, runs down to the low end of the channel, along the length of the drum. The drum revolves on rollers 3 mounted on water-



lubricated bearings 6. Sugar passing through the drum may also be treated simultaneously by a current of air through the interior.

* * *

Beet Harvester. V. L. NIELSEN, of Mern, Denmark. **795,916.** 18th October 1956; 4th June 1958.

* * *

Citric Acid Fermentation of Molasses Solution. USINES DE MELLE, of Melle (Deux-Sevres), France. **797,390.** 10th July, 1956; 2nd July, 1958.—The fermentation is carried out in two or three stages; in the first, a micro-organism which will ferment sugars to citric acid is grown on a medium so poor in sugar content as to have a Buffer Index (grams of pure HCl required to reduce the pH of 1 litre from 6·0 to 3·0) of 0·07—6 (1·5—3·0), and in which the amounts of nutrient elements is adjusted to control the growth. Fermentation is continued until the pH is reduced by the acid formed to 3·0 or lower. A solution of diluted molasses containing any necessary added sugar and/or nutrients is added at such a rate that the pH is maintained below 3 (2·5—2·9). At the end of this second stage, a proportion of the fermented material may be withdrawn and replaced by an equal volume of molasses solution containing any necessary added sugar and/or nutrients. During the second stage, an acid which does not interfere with the biochemical reaction of the micro-organism (e.g. citric acid) may be added.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 2s each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Martin-Markham "Rainmaker" Irrigation Set. Markham Traction Ltd., Lincolnshire Ironworks, Stamford, Lincs.

A centrifugal pump driven from the P.T.O. of a tractor delivers 50 to 400 gal/min depending on the head. The Martin-Markham "Rainmaker" Irrigation Set is suitable for irrigating an area of 50 to 100 acres. The water is pumped through seamless aluminium

alloy piping which can be supplied in lengths of up to 35 ft. Main piping of 4 in dia. and 3 in dia. lateral piping is used with this particular set. The quick-acting, pressure-cast alloy couplings ensure a perfect seal even on unlevel ground. Regular and even distribution of water over the land is provided by the sprinklers which are of the slow automatic rotating type working at low pressure. The sprinklers operate by the pressure of water on a balanced vane. A full range of pumps and allied equipment will shortly be available.

* * *

PUBLICATIONS RECEIVED.

MASSEY FERGUSON 35. Massey-Ferguson Ltd., Coventry, Warwickshire.

The new "35" is available in standard and "de luxe" versions, with alternative petrol, diesel and oil engines. Six forward and two reverse gears are provided by a combination of a normal and an epicyclic gearbox. Among many new features are a hydraulic system with double quadrant control, two different power take-off drives, and a dual clutch.

* * *

BELT-DRIVEN CANE MILLS. A. & W. Smith & Co. Ltd., 21 Mincing Lane, London E.C.3.

A new leaflet describes the Smith range of small belt-driven three-roller cane mills which range in roller size from 8 × 12 in, of capacity 10 tons per 12 hours, to 18 × 30 in, of 60 tons per 12 hours capacity. The headstocks, turn plate, roller pinions and compound gearing are of cast steel, while the rollers are of open-grain cast iron.

REFINING SUGAR SOLUTIONS WITH "DUOLITE" ION EXCHANGE RESINS. Chemical Process Company, 1901 Spring St., Redwood City, Calif., U.S.A.

A new 14-page booklet is devoted to various methods of demineralization and decolorising with resins of beet and cane juices and molasses, with sections on dextrose refining, glycerol purification, etc. In the main section, the treatment of beet thin juice and cane molasses and clarified juice are described, with reference to the economic considerations, selection of resins and also problems which arise. The booklet discusses the mixed bed and reverse ion-exchange demineralization techniques, and also refers to the decolorising resins which operate in the quaternary ammonium chloride form to adsorb colour from sugar syrups.

* * *

STORDY-HAUCK COMBUSTION EQUIPMENT. Stordy Engineering Ltd., Cumbria House, Goldthorn Hill, Wolverhampton.

A new leaflet series describes the "Stordy-Hauck" proportioning oil burner, micro-cam oil valve and self-cleaning metering valve.

* * *

"SURESEAL" VALVE. W. S. Barron & Son Ltd., Gloucester.

The patented "Sureseal" valve is adapted to the control of solids flow through the spout of a bag-filling hopper. It is dust-tight and is designed to provide full-bore passage without impediment. It operates by the action of two pneumatically operated cylinders sealing or opening a 6-inch diameter flow line and can also be supplied for hand operation.

* * *

GRINDING AND PULVERIZING BY IMPACT. Henry Simon Ltd., Cheadle Heath, Stockport, Cheshire.

A new booklet describes the "Entoleter" range of pulverizers which are available in a capacity range of up to 20,000 lb per hour. The essential mechanism is a high-speed rotor enclosed in a steel casing. The rotor is composed of two horizontal discs about 1¼ inches apart and material fed through inlet spouts to the centre of the rotor is hurled outward by centrifugal force. It strikes and disintegrates against a series of stationary pins mounted on a removable liner inside the steel casing. Sugar is among the materials powdered using the machine.

* * *

IN-LINE HELICAL GEAR DRIVES. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

A new six-page supplement (Folder 2651-A), for addition to the previous book on these gear units, contains complete data on h.p. ratings, dimensions, mounting information, etc., applying to the new quadruple-reduction speed-reducers. The supplement also contains information on two sizes of double-reduction helical gear drives and three sizes of triple-reduction units in addition to the five sizes of quadruple-reduction drives.

* * *

Mirrlees Watson Co. Ltd. Expansion.—The Mirrlees Watson Company Limited, of Glasgow, have purchased the old established firm of Messrs. Pott, Cassels & Williamson, also of Glasgow. Pott, Cassels & Williamson, now a limited company, will continue business under their own name. Robert Williamson, one of the original partners, served his apprenticeship with The Mirrlees Watson Company, and his father before him is known to have been employed by the firm around 1850.

Dominican Republic—Sugar Exports[1]

Destination.	1957 (*Metric Tons, tel quel*)*	1956 (*Metric Tons, tel quel*)*
EUROPE:		
Belgium	14,056	5,007
Eire	46,260	19,586
Germany	99,698	48,110
Greece	12,911	9,150
Holland	55,454	43,093
United Kingdom	417,924	410,878
Total Europe	646,303	535,824
NORTH AND SOUTH AMERICA:		
British West Indies	179	—
Canada	3,452	—
Dutch West Indies	4,218	5,840
United States	65,342	42,091
Total North and South America	73,191	47,931
ASIA, AFRICA AND OCEANIA:		
Ceylon	—	8,991
Iran	—	10,176
Japan	39,047	77,472
Korea (South)	—	9,680
Lebanon	—	3,072
Syria	7,983	—
Total Asia, Africa and Oceania	47,030	109,391
GRAND TOTAL	766,524	693,146

[1] *Lamborn*, 1958, **36**, 152.

* Principally raw sugar.

Brazil—Sugar Exports[1]

Destination.	1957 (*Metric Tons, tel quel*)*	1956 (*Metric Tons, tel quel*)*	1955 (*Metric Tons, tel quel*)*
Bolivia	426	258	330
Burma	—	—	9,641
Ceylon	12,339	4,150	13,816
Chile	20,225	—	—
Czechoslovakia	—	—	22,092
Ecuador	—	—	9,958
Egypt	55,412	—	—
Eire	—	—	29,911
Finland	17,294	—	—
France	9,002	—	14,609
Germany (West)	—	—	33,773
Holland	12,763	—	—
Hungary	—	—	10,770
Iceland	2,044	—	1,300
India	—	—	15,976
Iran	—	—	20,593
Iraq	3,370	—	—
Israel	15,332	—	—
Japan	1,564	—	130,940
Morocco	19,499	—	—
Netherlands	—	—	46,971
Pakistan	16,847	—	35,487
Portugal	15,997	—	25,452
Spain	27,837	—	—
United Kingdom	139,789	4,429	79,595
Uruguay	30,148	14,545	56,954
U.S.S.R.	—	—	8,331
Yugoslavia	—	—	9,267
Total	399,888	23,382	575,766

[1] *Lamborn*, 1958, **36**, 170.

* Consists of high polarizing "crystal" sugars, refined and Demerara type sugars.

BREVITIES

Erratum.—On page 228 of our August issue a Table III was introduced in error from another article. This Table III should be ignored.

* * *

Erratum.—The formula, given on page 200 of our July 1958 issue, for calculating the basicity of basic lead acetate should have read :

$$\text{Basid Pb \% total Pb} = \frac{50\dagger - \text{ml } 0{\cdot}1N \text{ NaOH}}{50\dagger - \text{ml } 0{\cdot}1N \text{ } KMnO_4} \times 100$$

† 25 ml in the case of dilute B.L.A. solutions.

* * *

Corrigendum.—A report of a new South African factory to be erected in Durban, quoted in our last issue[1], is incorrect and refers to the factory for Mhlume (Swaziland) Sugar Co. Ltd., mentioned in our June issue[2].

* * *

The Sugar Terminal at Matanzas, Cuba[3].—Erection of two stores started in February 1957 and expected to be complete by December 1958 in time for operation during the 1959 crop. Both are parabolic in section and the larger has a capacity of 750,000 bags of sugar of 250 lb each, i.e. a total of 93,750 short tons of sugar. The smaller store will hold 500,000 bags of sugar, or 62,500 tons. The bags will be moved in the store with fork-lift trucks and, for recovery, will be carried by rail to the ship loading store which will hold 8000 tons of bulk sugar and deliver into ships' holds at a rate of 800 tons per hour.

* * *

Bulk Storage in Queensland[4].—The second of Queensland's bulk sugar terminals at Lucinda Point began operating on the 12th June. Sugar will be brought from the Victoria, Macknade and Tully mills and stored in an 80,000-ton shed from which it will be reclaimed and loaded into ships at 600 tons per hour[5]. Sugar from Victoria and Macknade will be brought direct to the shed on mill tramlines, but Tully sugar will be transferred from rail wagons to road trailers at Lilypond, a few miles from Lucinda. The sugar will be carried in the standard sugar boxes. A gantry loader at the wharf, fed by a conveyor system from the shed, will be used to load the ships.

* * *

Sugar Cane in Iran.—Development and Resources Corporation of New York has engaged the Ralph M. Parsons Co. of Los Angeles to help establish a $23,000,000 sugar cane plantation and sugar refinery project in Iran. Assistance will be provided by Hawaiian Sugar Co. Ltd., a subsidiary of C. Brewer & Co. Ltd., of Honolulu. In the first stage the project will involve a 10,000-acre cane plantation, a mill with a daily grinding rate of 3000 tons. and a refinery which will produce about 30,000 tons of refined sugar (8% of Iran's annual sugar consumption) when in full operation. Iran now imports more than 65% of its sugar, obtaining the remainder from sugar beets grown in the northern provinces. The Khuzestan sugar cane project will be designed and built so that production can be doubled later by expansion of the planted area and factory facilities at minimum additional cost. The region was once famous for its sugar cane plantations, watered by extensive irrigation canals; these were destroyed, however, following the Mongol invasion, and cane production ceased. All equipment for factory, refinery and field operations will be purchased on an international bidding basis, and work will begin this autumn on the irrigation system which will receive water from the Dez river. The first operating season will be in 1961/62, when the crop on 5000 acres will be harvested. The full 10,000 acres will be harvested the following season.

[1] *I.S.J.*, 1958, **60**, 248.
[2] *I.S.J.*, 1958, **60**, 154.
[3] *Cubazúcar*, 1958, **3**, (8), 8–10.
[4] *Australian Sugar J.*, 1958, **50**, 309–311.
[5] *Queensland News Letter*, 24th July 1958.

BREVITIES

Bagasse Paper in Trinidad[1].—The possibility of establishing a £6 million pulp and paper mill has been under discussion between the Government of Trinidad and the U.K. manufacturers, Albert E. Reed & Co. An official of the latter has announced that they are satisfied with the prospects. The main material used would be bagasse and the factory would have a potential production of 50,000 tons. One of the main problems is that the mill would require large quantities of water daily and in turn would need to ensure the safe disposal of the effluent.

* * *

South Viet-Nam Sugar Imports.[2]—South Viet-Nam produces only about 20,000 tons of brown sugar per year. The planting area is estimated at 15,000 hectares in the south and central part of the country. There is a very small so-called refinery located at Saigon with a daily refining capacity of 60 to 90 tons of sugar. The construction of a new refinery, with United States aid, is under consideration. The capacity of the new refinery is said to be 1000 tons of sugar per day. The price of the native brown sugar is almost as high as that of imported refined sugar. Imports of sugar during the past few years were as follows :

Year	*Raw Sugar* (*metric tons*)	*Refined sugar*
1955	42,925	10,994
1954	24,236	36,910
1953	31,638	22,532
1952	26,516	32,596
1951	18,533	19,295

Stock Exchange Quotations

London Stocks (*at 18th August* 1958)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	14/6
Antigua Sugar Factory (£1)	21/3
Booker Bros. (10s)	20/9
British Sugar Corp. (Ltd. (£1)	16/9
Caroni Ord. (2s)	4/9
Caroni 6% Cum. Pref. (£1)	17/3
Distillers Co. Ltd. (6s. 8d units)	25/9
Gledhow Chaka's Kraal (£1)	57/–
Hulett & Sons (£1)	74/–
Jamaica Sugar Estates Ltd. (5s units)	6/–
Leach's Argentine (10s units)	10/3
Reynolds Bros. (£1)	47/6
St. Kitts (London) Ltd. (£1)	51/3
Ste. Madeleine (Ord.) (£1)	25/6
Sena Sugar Estates (10s)	24/3
Tate & Lyle (£1)	58/–
Tate & Lyle Investments Ltd. (5s)	12/1½
Trinidad Sugar (5s stock units)	12/6
United Molasses (10s stock units)	31/9
West Indies Sugar Co. Ltd. (£1)	29/–

New York Stocks (*at 16th August* 1958)

	CLOSING MIDDLE $
American Crystal ($10)	34¼
Amer. Sugar Ref. Co. ($100)	33
Central Aguirre ($5)	19⅜
Cuban American ($10)	27½
Great Western Sugar	27½
South P.R. Sugar	28½
United Fruit Co.	49
West Indies Sugar Corp. ($1)	58½

U.S.S.R. Beet Production 1957/58.[3]—According to official sources the 1957/58 sugar beet crop amounted to 38·5 million tons, or 6·9 million tons more than in the previous campaign.

* * *

Drought in Brazil.[4]—According to the U.S. Dept. of Agriculture a serious drought towards the end of the sugar campaign is reported from North-Eastern Brazil. Exports of sugar from North Brazil from the crop to be harvested this Autumn may be slow and total Brazilian exports may not be higher this calendar year than the 1955 record of 587,000 metric tons, raw values.

* * *

Indian Estimates for 1957/58.[5]—It is anticipated that the campaign this season will be of shorter duration than the 1956/57 one. Nevertheless the cane estimate of 21 million tons is 100,000 tons more than last season's outturn whilst, with sugar recovery expected to be in the region of 9·85%, compared with 9·72% in 1956/57, it is anticipated that sugar production will be in the region of 2,067,000 tons, an increase of 38,000 tons.

* * *

In-field Cane Transportation. Two tractors which run on huge balloon wheels have been sent to the Hawaiian Islands for testing, and another machine sent to the Dominican Republic. These tricycle-type tractors weigh two tons and carry a payload of 3000 lb. They move over any type of terrain and through snow, sand, or across boulders and fallen timbers. Only 2–3 lb per sq. in. pressure is put on the soft cane area by the machine.

* * *

Board Factory for Peru.[6]—It is planned to build a fibre board factory at San Jacinto in the Nepena valley, 380 km north of Lima, so as to process the 55,000 tons of bagasse produced by the sugar mill in operation there. The factory is to start production in 1960 and will produce 2·5 million square metres of board per year.

* * *

American Sugar Countries Conference[7].—The Cuban Sugar Stabilization Institute (I.C.E.A.) invited representatives of the sugar importing and exporting nations of the Americas—including Brazil, Canada, Cuba, Dominican Republic, Haiti, Mexico, Peru and U.S.A.—to meet in Havana during 28th to 31st July to consider important subjects to be discussed at a meeting of the International Sugar Council in Geneva on 22nd September. The Geneva meeting will consider matters affecting the International Sugar Market and the extension of the International Sugar Agreement which expires on 31st December 1958.

* * *

La Carlota Sugar Central, Philippines, 1956/57 Report.—during the season 710,163·175 tons of cane were crushed yielding a total of 93,563 tons of sugar including 81,327 tons of 97° pol raw sugar and 12,236 tons of 99·5° pol washed sugar. This crop was harvested from 11,455 hectares. Bad weather, including heavy rains, slowed milling operations and caused higher factory losses. Deeper roller grooving improved the capacity of the mills; boiler efficiency was raised by installing a forced draught fan, clarifier capacity was increased by adding one compartment to each unit; steam jet ejectors were installed on 3 pans, and the laboratory was remodelled. The Report is extensively illustrated with colour photographs.

---

[1] Barclays D.C. & O., *Overseas Review*, July 1958, 69.
[2] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 10), 13.
[3] F. O. LICHT, *International Sugar Report*, 1958, **90**, (6), 7.
[4] F. O. LICHT, *International Sugar Report*, 1958, **90**, (6), 9.
[5] C. Czarnikow Ltd., *Sugar Review*, 1958, (355), 93.
[6] *Economische Voorlichting*, 30th May, 1958.
[7] *Public Ledger*, 26th July 1958.